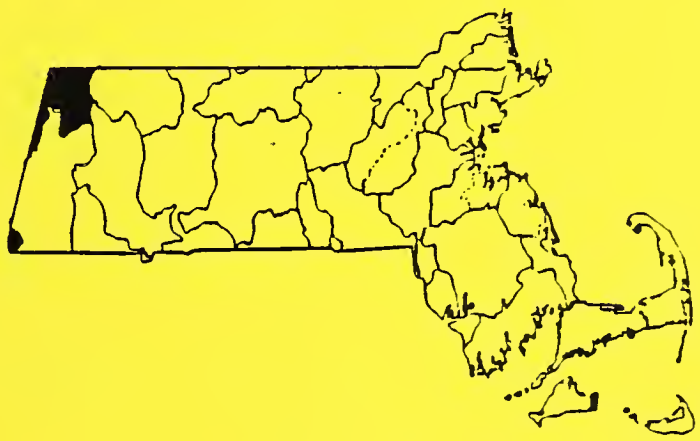
Volume 1

Hudson River Basin

Inventory and Analysis of Current and Projected Water Use



prepared by
Massachusetts Department of Environmental Management
Division of Water Resources

January 1989

for the
Massachusetts Water Resources Commission

Michael S. Dukakis, Governor • John DeVillars, Secretary • James Gutensohn, Commissioner

Hudson River Basin, Volume I
Inventory and Analysis of Current and Projected Water Use

Executive Office of Environmental Affairs
Water Resources Commission

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EXECUTIVE SUMMARY

* This report is the first step in developing a comprehensive water resources management plan for the Hudson River basin in Massachusetts. The Division of Water Resources has compiled data on existing water supply sources, water demand, and water use for communities with public water supplies in the Hudson River basin, and has projected water use through the year 2020. The inventory and analysis is intended to provide a basis for making sound decisions about water resource management. The following are summary points from the report.

* The Hudson River basin is located in portions of Massachusetts, New York, and Vermont. This study focuses on the portion located in western Massachusetts, comprised of three secondary basins draining approximately 202 square miles in Berkshire county. The three secondary basins in Massachusetts are the Hoosic River, Kinderhook Creek, and Bashbish Brook.

* The Hudson River basin study area includes 41,160 people in eight communities. Six public water supply systems serve 85 percent, or 35,071 persons, of the study area population. The other 15 percent, or 6,089 persons, obtain water from private wells. Five communities have public water supplies using Hoosic secondary basin water. Three communities in the study area have no public water supply system.

* The 1987 water demand on the public water supply systems in the Hudson River basin study area was 6.15 million gallons per day (mgd). The North Adams water supply system is the largest in the study area with a 1987 average day demand of 2.96 mgd, or 48 percent of the total 1987 water demand of public water supplies in the study area. If the 1987 maximum day demand for all five communities had occurred on the same day in 1987, the total amount of water used by the study area public water supply systems would have been 8.91 mgd.

* The total 1987 average day demand of 6.15 mgd was supplied from sources in the Hoosic River secondary basin. Surface water sources supplied 4.77 mgd, or 78 percent, of the water used by public water supply systems in 1987. Ground water sources supplied 1.38 mgd, or 22 percent, of the water used by public water supply systems in 1987.

* All water provided by public water supply systems used in the Hudson River basin in Massachusetts originated within the basin and was returned as wastewater discharge to the basin. Thus, the Hudson River basin in Massachusetts experienced neither a gain nor loss of water as a result of the operation of public water supply agencies in the study area during 1987.

* The 3-year 1985-1987 base average day demand, which is considered to be representative of current water use in the Hudson River basin, was 6.00 mgd. Population is expected to remain relatively stable throughout the planning period, however, a moderate increase in per capita use is expected. Thus, the average day demand is projected to increase from 6.00 mgd to approximately 7.02 mgd by the year 2020.

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PREFACE

The Massachusetts Water Resources Commission (WRC) has the primary responsibility for determining the state's water resources policy and directing the water resources planning activities for the Executive Office of Environmental Affairs. The Division of Water Resources (DWR), in the Department of Environmental Management, provides technical staff support to the Commission and is responsible, through the Commission, for long-range water resources planning for the Commonwealth. The central element in the development of a statewide water resources management plan is the preparation of a management plan for each of the twenty-seven river basins of the Commonwealth (See Figure 1). These plans are being developed pursuant to the Water Resources Planning Regulations (313 CMR 2.00) adopted by the Commission. The basin planning process includes local, regional, and state assessments of water needs and the availability of water resources. The plans also are in conformance with the Massachusetts Water Supply Policy Statement and are consistent with other water-related state and federal laws and regulations.

The river basin planning process (Table 1) consists of five steps:

1. Development of an inventory of the river basin's water supply and demand.
2. Analysis of data and identification of future water needs in the basin.
3. Development and analysis of alternatives to meet these projected needs.
4. Preparation of a basin-specific water resources management plan for the approval of the Water Resources Commission
5. Adoption of the plan by the WRC.

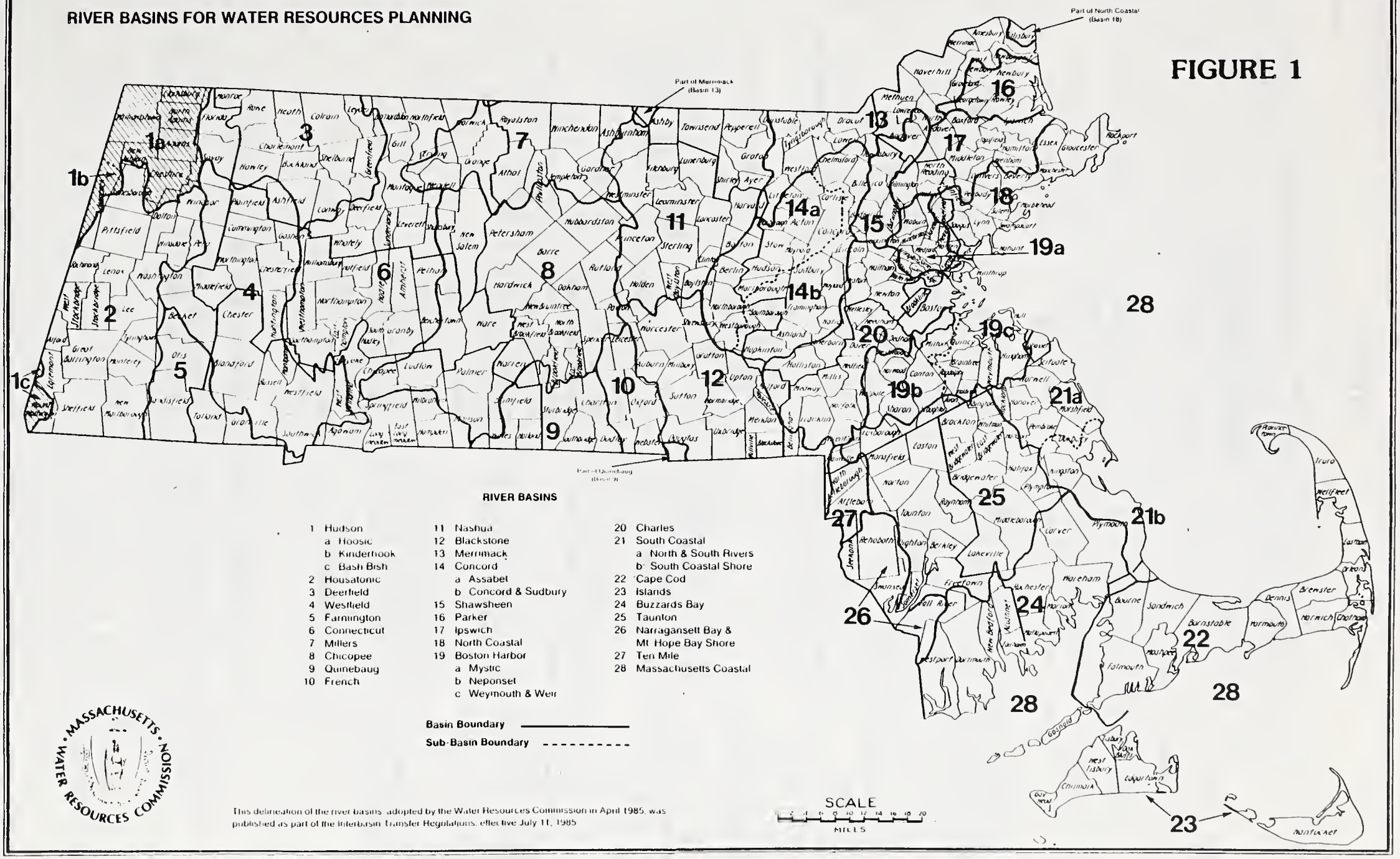
This first volume represents the inventory and analysis step of the planning process. It includes the collection of existing data on the river basin's current and projected water demand, water supply sources, and short- and long-term demographic profiles for communities in the basin.

The second volume will use the inventory data and short-and long-term water demand projections in a computer or other analytical model to determine sub-basin water yield in drought conditions. The analysis will include recommendations intended to protect a variety of instream and out of stream water uses, especially during low flow periods. These uses include wildlife, fin and shellfish, irrigation, hydropower, recreation, and wetlands, as well as providing for municipal and industrial supply and the dilution of wastewater effluent. When the analysis has been completed, a basin water budget can be prepared to estimate the volume of water available under drought conditions, while protecting or enhancing environmental quality. The basin water budget will provide an estimate of the basin's ability to meet projected demands with available resources and any planned water supply developments.

The third volume focuses on developing water supply alternatives, primarily for those communities which are projected to have difficulties meeting demand. The alternatives and recommendations developed in this step of the process are submitted to the WRC for review and adoption as the Hudson River Basin Plan.

FIGURE 1

RIVER BASINS FOR WATER RESOURCES PLANNING



RIVER BASINS

1 Hudson
- a Hoosic
- b Kinderhook
- c Bash Bish

2 Housatonic
3 Deerfield
4 Westfield
5 Farmington
6 Connecticut
7 Millers
8 Chicopee
9 Quinebaug
10 French
11 Nashua
12 Blackstone
13 Merrimack
14 Concord
- a Assabet
- b Concord & Sudbury

15 Shawsheen
16 Parker
17 Ipswich
18 North Coastal
19 Boston Harbor
- a Mystic
- b Neponset
- c Weymouth & Weir

20 Charles
21 South Coastal
- a North & South Rivers
- b South Coastal Shore

22 Cape Cod
23 Islands
24 Buzzards Bay
25 Taunton
26 Narragansett Bay & Mt Hope Bay Shore
27 Ten Mile
28 Massachusetts Coastal

Basin Boundary ——————

Sub-Basin Boundary - - - - - - - - - -

SCALE
0 2 4 6 8 10 12 14 16 18 20
MILES

This delineation of the river basins adopted by the Water Resources Commission in April 1985, was published as part of the Interbasin Transfer Regulations, effective July 11, 1985

MASSACHUSETTS • WATER RESOURCES COMMISSION •

Executive Office of Environmental Affairs • Water Resources Commission

Prepared by the Department of Environmental Management • Division of Water Resources

TABLE 1

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

DIVISION OF WATER RESOURCES
RIVER BASIN PLANNING PROGRAM

RIVER BASIN PLANNING FORMAT

STEP 1 DEVELOP INVENTORY OF BASIN SUPPLY AND DEMAND	STEP 2 ANALYZE BASIN INVENTORY AND IDENTIFY FUTURE WATER NEEDS	STEP 3 DEVELOP AND ANALYZE ALTERNATIVES TO MEET PROJECTED NEEDS	STEP 4 PREPARE WATER RESOURCES MANAGEMENT PLAN	STEP 5 ADOPT PLAN
(a) Demographic profile of each Community from Federal, State, Regional and Community Studies. (b) Historical and existing water demand of each community. (c) Existing and proposed water supply sources and systems via questionnaire replies. (d) Water resources management structure and organization via questionnaire replies. (e) Water requirements for recreation, fish, wildlife, agriculture, hydropower and dilution. (f) Outline by DEQE of basin water quality. (g) Unregulated historical streamflow data.	(a) 1990-2020 population changes of each community. (b) 1995-2020 projected water demand of each community. (c) Analyze existing and proposed water supply sources and systems as presented in questionnaire replies. (d) Conservation measures reported in questionnaire replies compared to the state conservation guidelines i.e. retrofit, leak detection, system rehabilitation, public education, ground water protection. (e) Task Force analysis of minimum streamflow thresholds. (f) Relationship between available water resources, projected demand and minimum streamflow thresholds. (g) Community and basin deficits.	(a) Local alternatives to meet projected community water needs (conservation, infrastructure storage, interconnections with contiguous communities). (b) Preliminary regional alternatives (MWRA, diversions, new regional reservoirs, interconnection). (c) Analysis and comparison of the relevant economic, environmental and institutional impacts of the alternatives and assessment of their ability to meet future needs. (d) Identification of deficient communities using local alternatives and not using regional alternatives per Step 3(b)	(a) Selection by WRPTF for Step 3(d) communities of the best mix of new local and regional alternatives (Step 3 a & b) to meet deficits. (b) Selection of alternative(s) for all communities and basins. (c) Preparation of draft plan. (d) Review and comment by local, regional, and state agencies and the Water Resources Commission on draft basin plan. (e) Preparation of final plan based on review comment.	(a) WRC review of final draft plan. (b) WRC vote on plan's adoption or adoption with modification.

<---------- CONTINUOUS INTERACTION WITH LOCAL, REGIONAL AND STATE AGENCIES ---------->

The adopted plan is one of the factors included in decision making under the Interbasin Transfer Act, Water Resources ManagementAct and MWRA Contracts, as outlined in 313 CMR 2.00, Water Resources Management Planning Regulations.

I. INTRODUCTION

Purpose

The Hudson River tributaries, and the lakes, ponds, and aquifers located within its basin in Massachusetts provide a valuable resource for the communities of the region and the Commonwealth. The information in this volume provides a basis for sound water resources management in the Hudson River basin study area. The report includes 1987 water demand data for communities with public water supply sources, 1986 federal census estimates, 1995-2020 population forecasts, and 1995-2020 projected water demands.

Methods

Water use data was obtained from the superintendents of six public water supply systems (see Appendix 1) and from the Division of Water Supply, Massachusetts Department of Environmental Quality Engineering (DEQE). In 1987 and 1988, water supply superintendents were requested to update the 1982 Municipal Water Resources Management Plan - Phase II questionnaire. Each superintendent reviewed, updated, and verified the accuracy of the data. To obtain more detailed information on water use and supply, DWR staff interviewed each water supply superintendent either in person or by telephone.

The 1990 and 1995 population projections were obtained from the Massachusetts Institute for Social and Economic Research (MISER). These projections are based on the 1980 federal census and the 1986 federal census estimate. Using a modification of the MISER projection methodology, DWR staff projected population through 2020.

Base water demand for each community's public supply system was calculated by averaging its 1985-1987 average day demand (ADD). Because changes in population growth and water conservation in most communities since 1984 have caused earlier water use patterns to change, the 1985 to 1987 period was chosen as most representative of current water use. Water demand data for 1980 through 1987 is listed in section IV of this report.

Water demand projections for 1995-2020 were developed using the methodology outlined in Appendix 2. This methodology is based on assumptions concerning population growth and water use in the basin study area during the next thirty-three years. The methodology is a traditional water engineering planning approach to demand projections, refined to reflect the particular conditions found in Massachusetts. The water demand projections will be used in the analysis of basin water supply and demand to be carried out in Volume II. Individual water supply and conservation alternatives for each community will be detailed in the Basin Plan (Volume III).

The Basin Plan will include updated information, including conservation measures, new sources of supply that may have come on line, more recent population figures, and other information affecting demand which became available following publication of Volume I. Water demand projections may require periodic revision as new data becomes available, as the projection methodology improves, or as unforeseen social and economic changes occur. Therefore, the projections in Volume I may differ from those that appear in the final Basin Plan.

II. HUDSON RIVER BASIN DESCRIPTION

The Hudson River basin is located in portions of Massachusetts, New York, and Vermont. This study focuses on the portion located in western Massachusetts (see Figure 2) which is comprised of three secondary basins draining approximately 202 square miles in Berkshire county. The three secondary basins in Massachusetts are the Hoosic, Kinderhook, and Bashbish (Figure 3).

The Hoosic secondary basin drains approximately 165 square miles of land area, in the northwest corner of Massachusetts. This secondary-basin contains areas of relatively high relief, with elevations ranging from 3,487 feet on Mount Greylock, the highest point in Massachusetts, to approximately 560 feet at the Vermont state line.

The Hoosic River is a very significant feature of Berkshire county. From its headwaters in Cheshire, the river flows north to its confluence with the North Branch Hoosic River in North Adams. The North branch flows south from Vermont, crossing the Massachusetts-Vermont state line at Clarksburg, through Clarksburg and into the Hoosic River in North Adams. From its confluence with the North Branch, the Hoosic River flows northwest through Williamstown into southern Vermont and into the Hudson River in New York (Figure 3).

The Kinderhook secondary-basin, located in portions of Hancock, Lanesborough, and Richmond, drains approximately 22 square miles of land west into the Hudson River in the state of New York.

The Bashbish secondary-basin, located in the towns of Mount Washington and Egremont, drains approximately 15 square miles of land area west into the Roeliff Jansen Kill, in New York, which flows into the Hudson River.

The secondary-basins are geomorphologically similar, consisting of deep bedrock valleys and well-defined channels. The valley bottoms are covered by glacial outwash and lacustrine sediments. The sediments provide limited aquifer storage in the basins. Bedrock outcrops are common along the valley slopes and peaks except in areas where glacial till of varying thicknesses covers the bedrock. The steep slopes, and extensive bedrock exposures produce a flashy streamflow regime. In addition relatively few wetlands exist to buffer peak flows. Peak storm flows pass rapidly through the valleys. The Cheshire Reservoir in Cheshire and various flood control structures in Adams and North Adams provide channel improvement, which protects industrial and commercial establishments, residences, and public buildings.

In addition to providing water for public and private water supplies, the Hudson River basin's water resources provide important recreational opportunities essential to the continued economic stability of the region and an environment necessary for the propagation of resident fisheries. At the same time, the basin functions as a receiver of wastewater effluent.

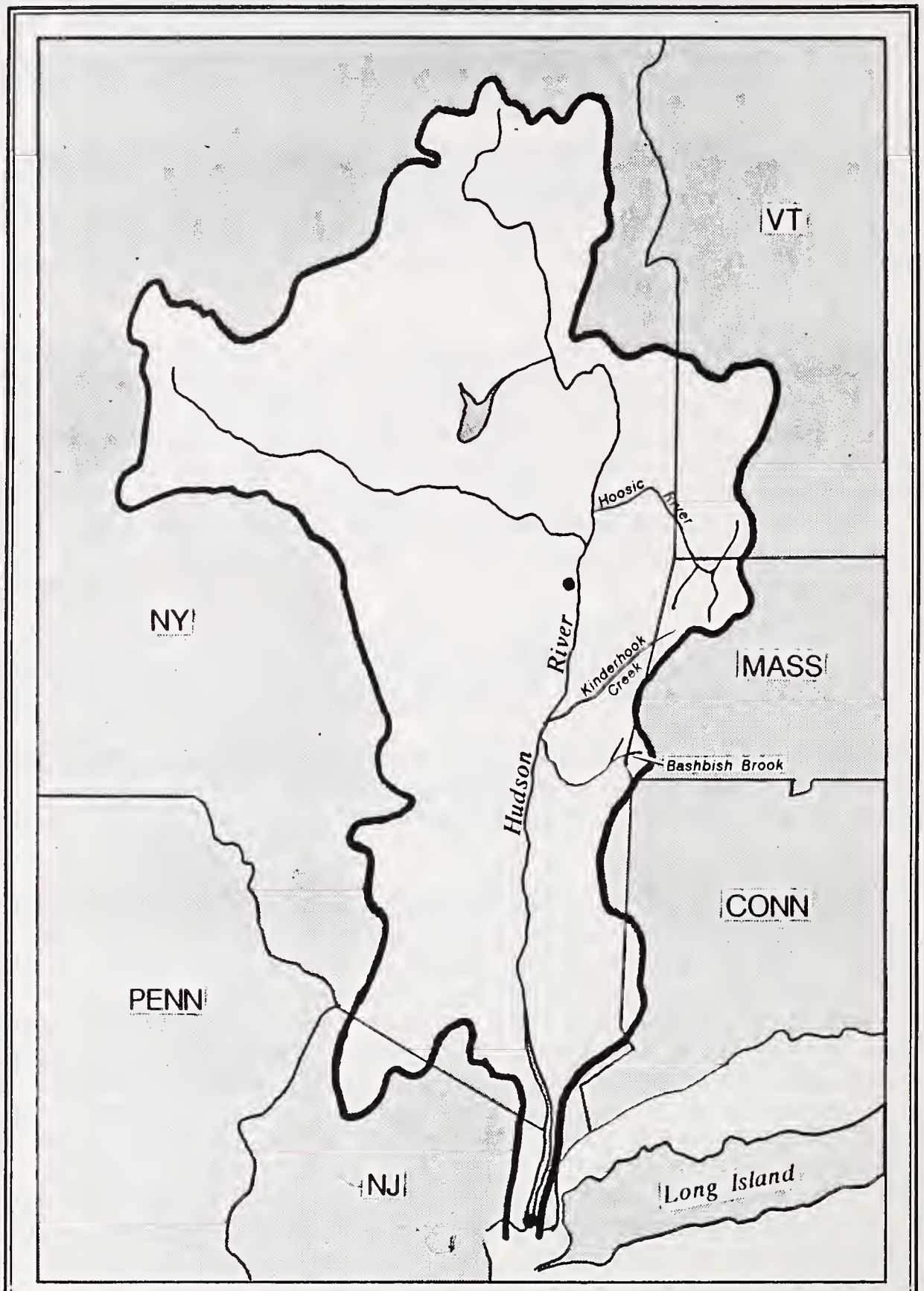
Sources of data:

Hydrology and Water Resources of the Hoosic River Basin, Massachusetts, Hydrologic Investigations Atlas, HA-481, USGS, 1973.

USDA, SCS Massachusetts Water Resources Study - Area Measurements, 1972

Gazetteer of Hydrologic Characteristics of Streams in Massachusetts - Hudson River Basin, USGS, Water Resources Investigations Report 83-4250, 1984

FIGURE 2



Hudson River Basin

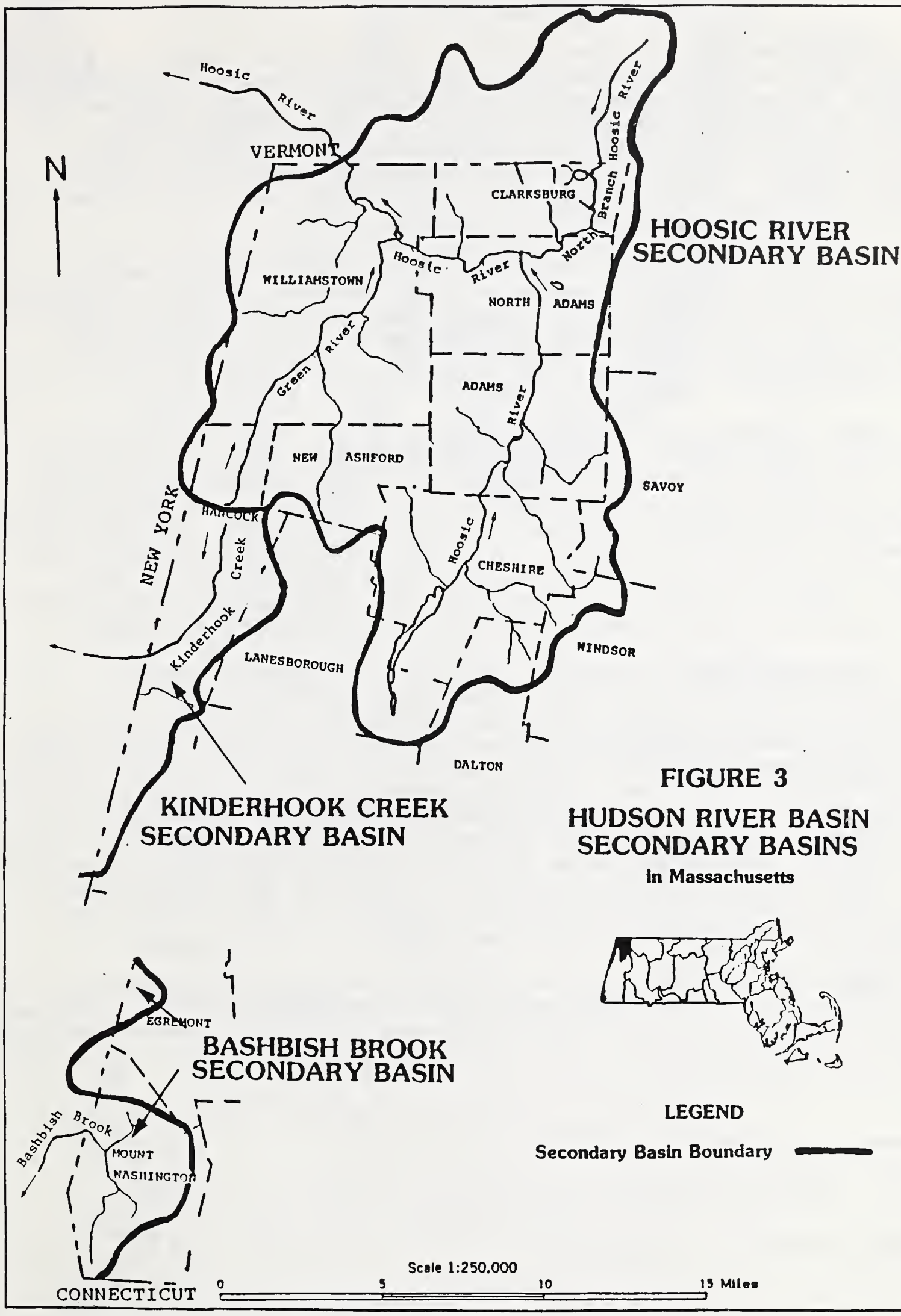


FIGURE 3

HUDSON RIVER BASIN
SECONDARY BASINS
in Massachusetts

III. HUDSON RIVER BASIN STUDY AREA DESCRIPTION

The Hudson River basin study area encompasses eight communities in Massachusetts that either use Hoosic, Kinderhook, or Bashbish secondary-basin water for public water supply systems or private on-site water supply (Figure 4). Five of the eight communities located within the Hoosic basin have public water supply systems, and the remaining three communities are supplied by on-site wells. All self-supplied residential water use in the Hudson River basin is assessed in Appendix 3-A.

The five communities in the study area with public water supply systems located in the Hoosic sub-basin are Adams, Cheshire, Clarksburg, North Adams, and Williamstown. The three towns without public supply systems are New Ashford, which is located in the Hoosic sub-basin; Hancock, located in the Kinderhook sub-basin; and Mount Washington, located in the Bashbish sub-basin.

Eight communities with portions of their land area located in the Hudson River basin are not included in the study because less than 50 percent of their land is in the basin and currently they have no public water supply sources within basin boundaries. These communities are Dalton, Egremont, Florida, Lanesboro, Pittsfield, Richmond, Savoy, and Windsor. No community located outside of the Hudson River basin has public water supply sources within the basin. Table 2 lists all communities with land area in the Hudson River basin and those communities selected for the study area.

There are numerous small, privately-owned water supply companies throughout the study area that serve from one to approximately 20 connections. The average day demand of each of these small water supply companies is less than 10,000 gallons per day and in most cases much less. Records of usage for the majority of these small companies' supplies is not readily available. It is assumed for the planning period that these service populations will not increase. The population served by this group of water suppliers is considered to be on-site self-supplied user. Appendix 3-B lists the water supply companies located in the Hudson River basin which served less than 10,000 gallons per day in 1987, as reported to DEQE, Division of Water Supply.

Appendix 3-C lists the self-supplied water using industrial facilities with water demand over 100,000 gallons per day. The data provided in Appendix 3-C is analyzed in Volume II of this report.

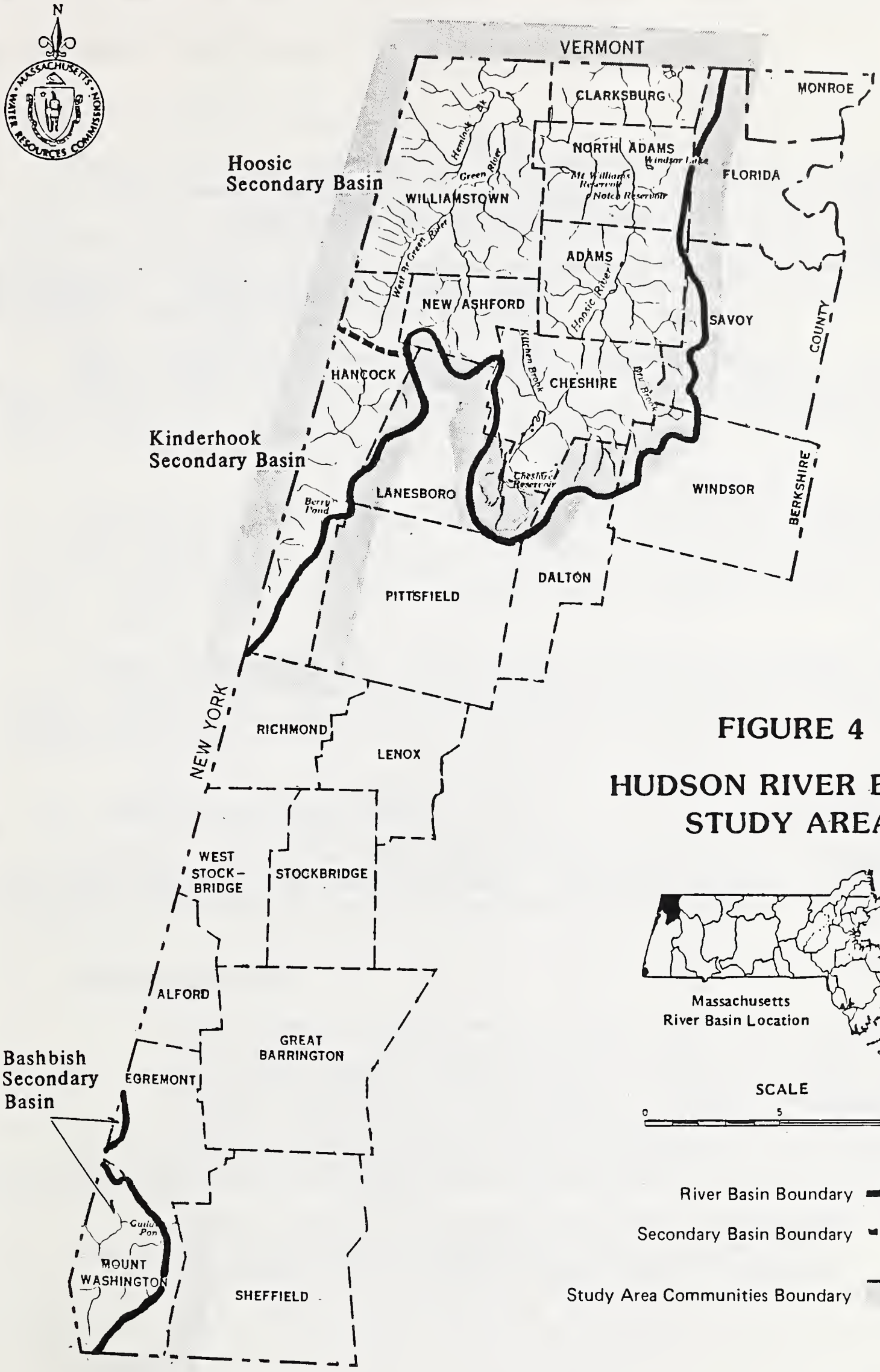


FIGURE 4

HUDSON RIVER BASIN STUDY AREA

SCALE

0 5 10 Miles

River Basin Boundary

Secondary Basin Boundary

Study Area Communities Boundary

Prepared by DEM / Division of Water Resource

TABLE 2

COMMUNITIES INCLUDED IN
HUDSON RIVER BASIN STUDY AREA

Community	Percent of Land Area in Hudson Basin	Water Supply Agencies with Sources in Hudson Basin	Significant Self Supplied Population in Hudson Basin	Communities Included in Study Area
ADAMS	98 %	X		X
CHESHIRE	99	X	X	X
CLARKSBURG	100	X	X	X
(Dalton)	17			
(Egremont)	2			
(Florida)	5			
HANCOCK	74		X	X
(Lanesboro)	27			
MOUNT WASHINGTON	67		X	X
NEW ASHFORD	93		X	X
NORTH ADAMS	95	X		X
(Pittsfield)	<1			
(Richmond)	2			
(Savoy)	11			
WILLIAMSTOWN	100	X	X	X
(Windsor)	7			

Note: Parentheses indicate communities having less than 50 percent of their land area in the Hudson Basin and no central water supply sources in the basin.

IV. HUDSON RIVER BASIN PUBLIC WATER SUPPLY SYSTEMS

1. 1987 Water Demand

Public water supply system customers in the study area had an average day demand (ADD) of 6.15 million gallons per day (mgd) in 1987. If the 1987 maximum day demand for all communities had occurred on the same day, the total amount of water used by the public water supply systems would have been 8.91 million gallons (Table 3). All six public water supply systems and customers are located in the Hoosic secondary-basin.

Five of the eight study area communities are served in part by six separate water supply systems: three municipal water departments, two privately-owned water supply utilities, and one Water District. Appendix 1 lists the public water supply agencies that serve the Hudson River basin communities.

The public water supply systems of North Adams and Adams are the largest in the study area, with 1987 demands of 2.96 mgd and 2.03 mgd respectively, totalling 4.99 mgd. This amounts to 81 percent of the total 1987 public water supply demand in the study area. North Adams and Adams comprise only 22 percent of the study area's land.

Figure 5 displays the 1987 monthly average day demands for basin communities. Monthly average day demand of public water supply users in the Hudson River basin was relatively constant throughout 1987.

2. Historical Water Demand

Tables 3 and 4 list 1980-1987 average and maximum day demand for each community in the study area. ADD has remained relatively constant from 1980 to 1987 at approximately 6.1 mgd.

Sources of Data:

Water demand figures were obtained from the 1980-1987 "Water Supply Statistics Reports" submitted each year by each water supply agency to the Division of Water Supply in the Department of Environmental Quality Engineering (DEQE). The average day demand for each year was calculated by dividing water consumption (in gallons) by 365 days (366 days, if a leap year).

TABLE 3

AVERAGE DAY DEMAND
HUDSON RIVER BASIN
million gallons per day (mgd)

COMMUNITY/ AGENCY	1980	1981	1982	1983	1984	1985	1986	1987
ADAMS								
FIRE DISTRICT	1.79	1.83	1.59	2.39	2.34	1.98	1.97	2.03
CHESHIRE								
WATER DEPARTMENT	0.22	0.25	0.21	0.21	0.20	0.19	0.15	0.15
HUTCHINSON WATER CO.	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
CLARKSBURG								
REDMILLS/BRIGGSVILLE	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
NORTH ADAMS								
WATER DEPARTMENT	2.95	2.83	2.91	2.77	2.33	2.89	2.78	2.96
WILLLIAMSTOWN								
WATER DEPARTMENT	1.09	0.96	0.95	0.86	0.85	0.86	0.96	0.97
TOTALS	6.08	5.90	5.69	6.26	5.75	5.96	5.90	6.15

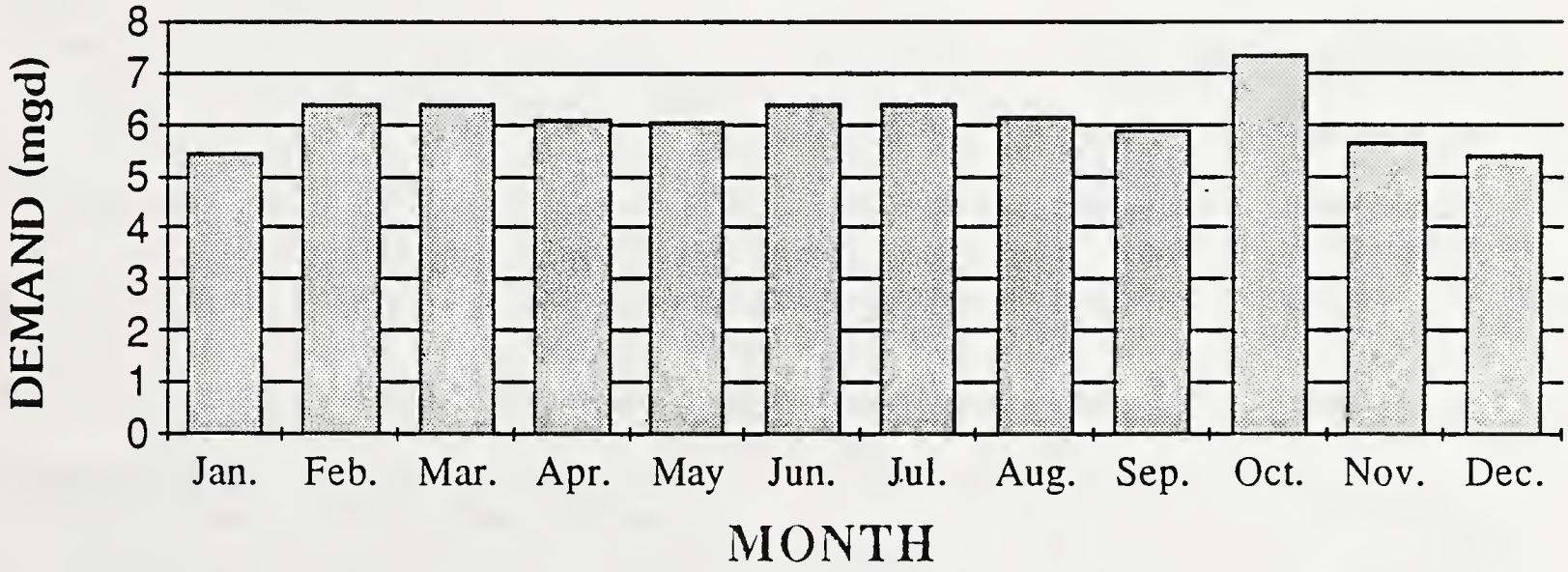
TABLE 4

MAXIMUM DAY DEMAND
HUDSON RIVER BASIN
million gallons per day (mgd)

COMMUNITY/ AGENCY	1980	1981	1982	1983	1984	1985	1986	1987
ADAMS								
FIRE DISTRICT	2.40	2.28	2.00	3.30	4.29	2.66	2.55	2.57
CHESHIRE								
WATER DEPARTMENT	0.33	0.30	0.34	0.26	0.27	0.26	0.23	0.32
HUTCHINSON WATER CO.	0.03	0.03	0.03	0.02	0.02	0.04	0.04	0.04
CLARKSBURG								
REDMILLS/BRIGGSVILLE	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
NORTH ADAMS								
WATER DEPARTMENT	4.17	3.78	4.36	3.54	3.50	4.34	4.17	4.44
WILLLIAMSTOWN								
WATER DEPARTMENT	1.35	1.30	1.35	1.32	1.14	1.17	2.13	1.53
TOTALS	8.29	7.70	8.09	8.45	9.23	8.48	9.13	8.91

FIGURE 5

1987 MONTHLY AVERAGE DAY DEMAND
HUDSON RIVER BASIN
(mgd)



Prepared by DEM/Division of Water Resources

3. 1987 Source of Supply

In 1987 the five study area communities with public water supplies obtained 100 percent of their water from sources within the Hoosic secondary-basin. These communities are Adams, Cheshire, Clarksburg, North Adams, and Williamstown. The remaining communities located in the study area have no public water supply systems.

Table 5 below lists the portion of each community's average day demand obtained from sources in the Hudson River secondary basins in 1987.

TABLE 5

SOURCES OF PUBLIC WATER SUPPLY, BY SECONDARY-BASIN
HUDSON RIVER BASIN
(million gallons per day)

Community Agency	SECONDARY BASINS Hoosic	Kinderhook	Bashbish	1987 Average Day Demand
Adams Fire District	2.03	0	0	2.03
Cheshire Water Dept.	0.15	0	0	0.15
Hutchinson Water Co.	0.03	0	0	0.03
Clarksburg Redmills	0.01	0	0	0.01
No. Adams Water Dept.	2.96	0	0	2.96
Williamstown W. Dept.	0.97	0	0	0.97
TOTALS	6.15 mgd	0	0	6.15 mgd

Appendices 4-A, 4-B, and 4-C identify and locate public water supply sources in the study area. Appendix 4-A lists the method of identifying public water supply sources; Appendix 4-B provides a map with Hudson River basin water supply source locations; and Appendix 4-C provides a table listing public water supply sites and source-specific information.

Appendix 5 contains community water supply facts summaries and a water supply sources map for each of the study area communities that have a public water supply system.

Sources of Data:

Each Municipal Water Resources Management Plan - Phase II questionnaire (1982) includes a map showing the location of the water supply system's source(s). This information was updated during interviews with water superintendents in 1987 and verified in 1988 when the superintendents reviewed and verified community summary sheets and maps. The 1987 DEQE Division of Water Supply Statistics Sheets, Section 2, provided pumpage data for each public water supply source.

4. 1987 Type of Supply

In 1987, surface water sources supplied 4.77 million gallons per day (mgd), or 78 percent, of water used by public water supply systems. Ground water sources supplied 1.38 mgd, or 22 percent, of water used by public water supply systems in 1987. The three largest public water supply systems, Adams, North Adams, and Williamstown, obtain most of their supply from surface water sources. Table 6 below lists the amounts and percentages of surface and ground water used in 1987.

The towns of New Ashford, Hancock, and Mount Washington have no public water supply systems and obtain water from private on-site wells.

TABLE 6

1987 TYPE OF WATER SUPPLY
HUDSON RIVER BASIN
(mgd and percent)

Community/ Agency	1987 Average Day Demand	SURFACE WATER USE mgd	SURFACE WATER USE percent	GROUND WATER USE mgd	GROUND WATER USE percent
Adams Fire Dist.	2.03	1.32	65 %	0.71	35 %
Cheshire Water Dept.	0.15	0.15	100	0	0
Hutchinson Water Co.	0.03	0	0	0.03	100
Clarksburg Red Mills	0.01	0	0	0.01	100
North Adams Water Dept.	2.96	2.70	91	0.26	9
Williamstown Water Dept.	0.97	0.60	62	0.37	38
TOTAL	6.15 mgd	4.77 mgd	78 %	1.38 mgd	22 %

Sources of Data:

The quantity of surface and ground water used for each water supply system was determined from the DEQE Division of Water Supply, 1987 water supply statistics reports, section 2, and/or through interviews with water supply officials.

5. 1987 Estimated Distribution of Water Use

Community water supply agency officials were asked to estimate the water used in various categories. Some communities are metered and officials can give an accurate accounting of the water consumed in each water use category. Other systems are unable to break down water use by category and provide estimated quantities. The numbers quoted in table 7 should be regarded as estimates.

The residential component places the largest demand on the public water supply systems in the Hudson River basin.

Commercial and industrial water use is significant for the communities of Adams, North Adams, and Williamstown.

Unaccounted-for water is the most difficult category of water use to define, since its meaning is open to interpretation. As a result, different methods were used by local water supply agencies to calculate water use in this category. Unaccounted-for water may include water lost through leakage, water used to flush mains, or water furnished to municipal buildings. Some systems have ways to estimate this water use, others do not; the accuracy of reporting varies from system to system.

Water use categories are defined below. Table 7 lists the estimated 1987 distribution, by percentage, for different categories of water use, as reported by water supply officials.

Water Use Definitions

Residential-	water used by individuals and families in houses, apartments, condominiums and mobile home parks
Commercial-	water used by business other than industry
Municipal-	water used by municipal buildings, backflushing, fire-fighting, street cleaning, etc.
Industrial-	water used by industries for processing, cooling sanitary, etc.
Other-	water wholesaled to other public water supply systems in or out of the community
Agricultural-	water used by the farming industry for irrigation or livestock
Unaccounted-for use	unmetered use including water used by municipal buildings, system flushing and maintenance, leakage, fire fighting, etc.

Sources of Data:

The percent distribution of water use for each water supply system was obtained from the 1987 "Water Supply Statistics Report" submitted by the system's superintendents to DEQE, Division of Water Supply and/or interviews with local water supply officials.

TABLE 7

1987 ESTIMATED DISTRIBUTION OF WATER USE
HUDSON RIVER BASIN
(percent)

Community	Residential Water Use	Commercial Water Use	Industrial Water Use	Agricultural Water Use	Municipal Water Use	Other Water Use	Unaccounted for Water Use
Adams							
Fire District	50%	10%	15%	10%	5%	0	10%
Cheshire							
Water Dept.	95	3	0	0	2	0	0
Hutchinson Water	98	2	0	0	0	0	0
Clarksburg Red Mills							
Briggsville W.S.	95	0	5	0	0	0	0
North Adams							
Water Department	32	------20------		0	4	0	44
Williamstown							
Water Department	49	14	3	4	2	0	28

6. 1987 Basin Inflow-Outflow Analysis

One hundred percent of the water provided by public water supply systems in the Hudson River basin originated in the Hoosic secondary basin. All of the water was returned to the Hoosic secondary basin by on-site septic systems and wastewater treatment plant discharges.

The Hoosic River received approximately 91 percent of the wastewater discharge generated by public water supply users in the Hoosic secondary-basin through two wastewater treatment plants located in Adams and Williamstown, adjacent to the Hoosic River.

The treatment plant in Adams serves approximately 90 percent of the public water supply users in Adams. The Hoosic Water Quality District plant, located in Williamstown, serves approximately 98 percent of the public water supply users in Williamstown and 95 percent in North Adams. The remaining 9 percent of the population supplied by public water supply systems discharges wastewater through on-site septic systems throughout the Hoosic secondary basin.

For each community with a public water supply in the study area, Table 8 displays the source of 1987 public water supply and the basin where wastewater was discharged. This analysis shows that all public water supply sources serving the Hudson River basin communities are located in the Hoosic secondary basin, and all publicly-supplied water was discharged back into the Hoosic secondary basin. The Hudson River basin experienced neither a gain nor loss of water as a result of the operation of public water supply agencies in the study area during 1987.

TABLE 8

1987 INFLOW-OUTFLOW
HUDSON RIVER BASIN *
(mgd)

Town/ Agency	Basin of Supply Origin and 1987 ADD	Basin of Disposal of 1987 ADD	Estimated Volume of 1987 ADD (mgd) Disposed by Wastewater Treatment Plant	Estimated Volume of 1987 ADD (mgd) Disposed by on site septic Systems	1987 Average Day Demand (mgd)
Adams					
Fire District	Hudson 2.03	Hudson 2.03	1.83 mgd	0.20 mgd	2.03 mgd
Cheshire					
Water Department	Hudson 0.15	Hudson 0.15	----	0.15	0.15
Hutchinson Water Co.	Hudson 0.03	Hudson 0.03	----	0.03	0.03
Clarksburg					
Redmills/Briggsville	Hudson 0.01	Hudson 0.01	----	0.01	0.01
North Adams					
Water Department	Hudson 2.96	Hudson 2.96	2.81	0.15	2.96
Williamstown					
Water Department	Hudson 0.97	Hudson 0.97	0.95	0.02	0.97
TOTALS (mgd)	6.15	6.15	5.59	0.56	6.15 mgd
(Percent of ADD)			(91%)	(9%)	

* All public water supply agencies in the Hudson River basin study area are located in and provide water within the Hoosic River secondary basin.

V. HUDSON RIVER BASIN DEMOGRAPHIC PROFILE

1. Population and Population Trends

According to the federal census, in 1980, the Hudson River basin study area communities had a population of 43,075. The 1986 federal census estimate of 41,160 showed a decrease of 1,915 persons (4 percent) during the six-year period.

North Adams has the largest population of the eight study area communities. The 17,020 residents of North Adams accounted for 41 percent of the basin population in 1986. Table 9 shows population changes from 1940 to 1986. From 1940 to 1970, the area experienced a moderate increase in population from 42,616 to 45,253, or a 6 percent rise. During the ten years from 1970 to 1980 the population decreased by 2,178, or 5 percent.

Illustrated below are numerical and percentage changes in population from 1940 to 1986.

PERIOD	NUMERICAL CHANGE in persons	PERCENTAGE INCREASE/DECREASE
1940-1950	1428	3 %
1950-1960	441	1
1960-1970	768	2
1970-1980	-2178	-5
1980-1986	-1915	-4

Sources of Data:

The 1980 federal census figures, "Number of Inhabitants Massachusetts-1980 Census of Population" and the 1986 federal census estimates are prepared by the Bureau of Census, U.S. Department of Commerce. These figures include all persons indicating a particular city or town as their place of residence. Armed forces members living on a military installation were counted as residents of the community in which the installation is located. College students were counted as being residents of the area in which they are living while attending college. Inmates of institutions who ordinarily live there for a considerable period of time were counted as residents of the community where the institution is located.

TABLE 9

POPULATION TRENDS
HUDSON RIVER BASIN

Community	Federal Census 1940	1950	1960	1970	1980	1986 *	Population Change 1980-86	Percent Change in Population 1980-86
Adams	12,608	12,034	12,391	11,772	10,381	10,080	-301	-3%
Cheshire	1,708	2,022	2,472	2,935	3,124	3,340	216	7%
Clarksburg	1,317	1,630	1,741	1,987	1,871	1,790	-81	-4%
Hancock	332	445	455	675	643	600	-43	-7%
Mt. Washington	57	34	34	52	93	100	7	8%
New Ashford	87	118	165	183	159	140	-19	-12%
North Adams	22,213	21,567	19,905	19,195	18,063	17,020	-1043	-6%
Williamstown	4,294	6,194	7,322	8,454	8,741	8,090	-651	-7%
TOTALS	42,616	44,044	44,485	45,253	43,075	41,160	-1915	-4%

* Federal Census Estimate

2. Population Density

The City of North Adams is the most populous and most densely populated community in the study area, with a 1986 population of 17,020 persons and a population density of 825 persons per square mile. The town of Mt. Washington has the lowest population and population density in the study area, with a 1986 population of 100 and a population density of 4 persons per square mile.

Residents of the five communities with public water supplies (Adams, Cheshire, Clarksburg, North Adams, and Williamstown) account for 98 percent of the population and occupy 65 percent (130.6 square miles of 202.4 square miles) of the study area. The remaining 840 persons, or two percent of the population, residing in the three communities without public supplies (Hancock, New Ashford, and Mount Washington) occupy 35 percent of the study area, or 71.8 square miles. The 1986 federal census estimate, land area in square miles, and population density of each community is shown in Table 10.

Sources of Data:

Land area information for each community was obtained from the Soil Conservation Service, U.S. Dept. of Agriculture. The population density figures were calculated by dividing the 1986 federal census estimate figures by the land area of each community.

TABLE 10

1986 FEDERAL CENSUS ESTIMATE,
COMMUNITY LAND AREA, AND DENSITY
HUDSON RIVER BASIN
(Arranged in descending order)

1986 Federal Census Estimate		Land Area (in square miles)		Density (persons per square mile)	
North Adams	17,020	Williamstown	46.73	North Adams	825
Adams	10,080	Hancock	36.03	Adams	439
Williamstown	8,090	Cheshire	27.51	Williamstown	173
Cheshire	3,340	Adams	22.94	Clarksburg	140
Clarksburg	1,790	Mt. Washington	22.33	Cheshire	121
Hancock	600	North Adams	20.62	Hancock	17
New Ashford	140	New Ashford	13.47	New Ashford	10
Mt. Washington	100	Clarksburg	12.82	Mt. Washington	4
TOTALS	41,160		202.45		203

3. Service Population

Of the 41,160 persons living in the Hudson River basin study area, 35,071, or 85 percent, obtained their water from a public water supply system in 1987. Five of the eight study area communities have public water supply systems. The remaining 6,089 persons (15 percent) are supplied by private on-site wells (see Appendix 3-A).

Adams Fire District in the Town of Adams provides 94 percent of the town population with water. Two water supply agencies serve portions of the Town of Cheshire. Cheshire Water Department serves 59 percent and Hutchinson Water Company serves 9 percent of the town population. Redmills/Briggsville Water Supply Company serves 10 percent of the town population in Clarksburg. North Adams Water Department serves 97 percent of the population in the City of North Adams. North Adams Water Department also serves 100 persons living in Clarksburg and 64 persons living in Williamstown for a total of 164 outside of the city. Williamstown Water Department serves 80 percent of the population in Williamstown.

Table 11 shows the percent of population served by public water supply systems in 1987 in the study area.

Sources of data:

The 1987 service population represents the percent of the 1986 federal census estimated population that is served by the community's public water supply system(s). If a community's 1987 service population is 90 percent, it means that 90 percent of the population is on a public supply system, and the other 10 percent of the population is self-supplied by wells, or served by another community's water supply system.

This information was reported to DWR in recent interviews with municipal officials and water supply agency superintendents.

TABLE 11

1987 SERVICE POPULATION
HUDSON RIVER BASIN

Community/Water Department	1986 Federal Census Population	1987 Percent Service Population	1987 in Town Service Population	Out of Town Population	1987 Total Service Population
Adams	10,080				
Water Department		94%	9,475	0	9,475
Cheshire	3,340				
Water Department		59%	1,971	0	1,971
Hutchinson Water Co.		9%	301	0	301
Clarksburg	1,790				
Redmills/Briggsville		10%	179	0	179
Hancock (1)	600	--	--	--	--
Mount Washington (1)	100	--	--	--	--
New Ashford (1)	140	--	--	--	--
North Adams (2)	17,020				
Water Department		97%	16,509	164	16,673
Williamstown	8,090				
Water Department		80%	6,472	0	6,472
TOTALS	41,160	85%	34,907	164	35,071

(1) Communities with no central water supply.

(2) North Adams Water Department serves 100 persons in Clarksburg and 64 persons in Williamstown.

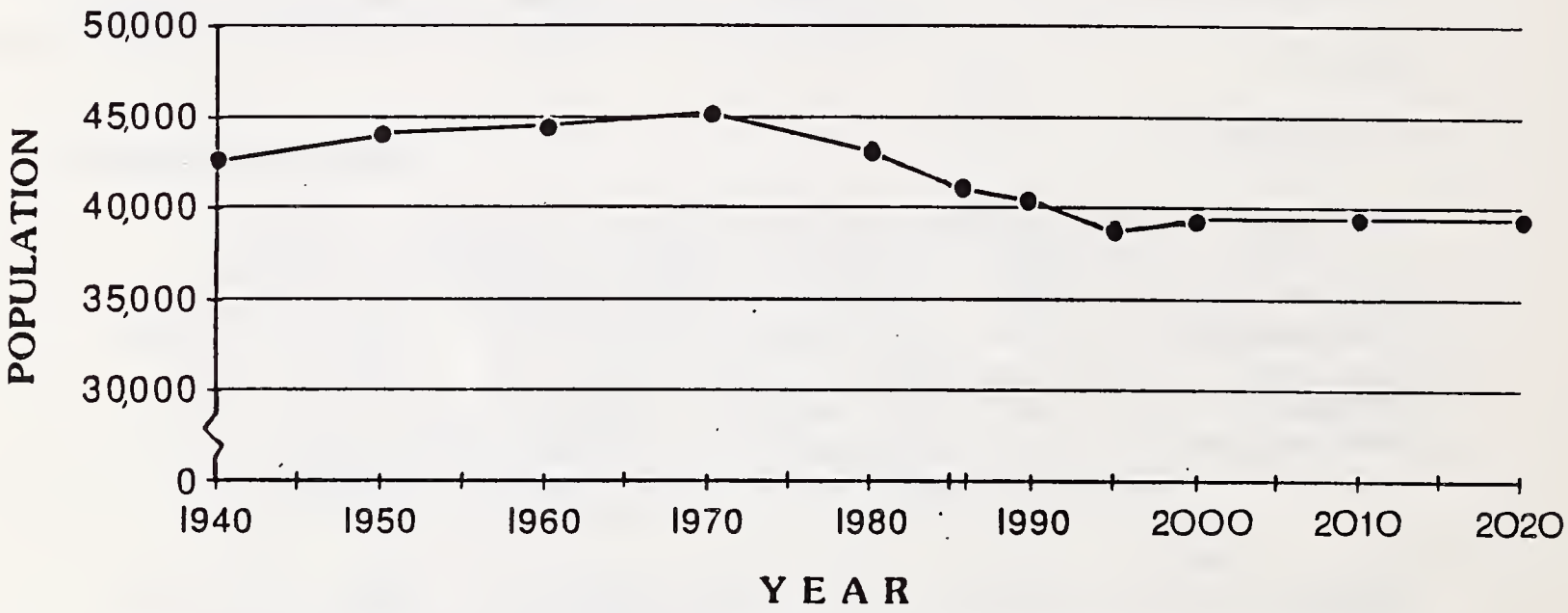
4. Population Projections

The population of the Hudson River basin is projected to decrease by 4 percent from 41,160 in 1986 (federal census estimate) to 39,358 in 1995 (MISER projection). Based on the MISER projections and conversations with local officials, DWR expects population to remain fairly stable, at approximately 39,400, from 1995 to 2020.

Figure 6 and Table 12 detail the historical and projected population trends in the study area from 1940 to 2020. Community population percent and numerical changes are listed in Table 13.

FIGURE 6

HUDSON RIVER BASIN
POPULATION 1940 - 2020



Source of Data

Population projections are based on projections for 1990 and 1995 by MISER and information provided by municipal officials. These sources provide specific knowledge of growth patterns in individual communities as well as a comprehensive statewide perspective. MISER projections were based on the 1980 Federal census and the 1986 Federal census estimate. Using this information and a modification of the MISER projection methodology, it was estimated that population in the study area will remain at the 1995 population as projected by MISER throughout the planning period.

TABLE 12

POPULATION TRENDS AND PROJECTIONS
HUDSON RIVER BASIN

	Federal Census						Population Projections				
Community	1940	1950	1960	1970	1980	1986*	1990 (1)	1995 (1)	2000 (2)	2010 (2)	2020 (2)
Adams	12,608	12,034	12,391	11,772	10,381	10,080	9,947	9,666	9,666	9,666	9,666
Cheshire	1,708	2,022	2,472	2,935	3,124	3,340	3,344	3,293	3,293	3,293	3,293
Clarksburg	1,317	1,630	1,741	1,987	1,871	1,790	1,762	1,713	1,713	1,713	1,713
Hancock	332	445	455	675	643	600	586	558	600	600	600
Mt. Washington	57	34	34	52	93	100	101	100	100	100	100
New Ashford	87	118	165	183	159	140	139	134	160	160	160
North Adams	22,213	21,567	19,905	19,195	18,063	17,020	16,681	16,095	16,095	16,095	16,095
Williamstown	4,294	6,194	7,322	8,454	8,741	8,090	8,006	7,799	7,800	7,800	7,800
TOTALS	42,616	44,044	44,485	45,253	43,075	41,160	40,566	39,358	39,427	39,427	39,427

* Federal Census estimate

(1) MISER projection

(2) Division of Water Resources projection

TABLE 13

PERCENTAGE AND NUMERICAL
CHANGES IN POPULATION
HUDSON RIVER BASIN

Community	1986 Federal Census Population	2020 Projected Population	1986-2020 Percent Change in Population	1986-2020 Numerical Change in Population
Adams	10,080	9,666	-4%	-414
Cheshire	3,340	3,293	-1%	-47
Clarksburg	1,790	1,713	-4%	-77
Hancock	600	600	0%	0
Mt. Washington	100	100	0%	0
New Ashford	140	160	14%	20
North Adams	17,020	16,095	-5%	-925
Williamstown	8,090	7,800	-4%	-290
Totals	41,160	39,427	-4%	-1,733

5. Projected Service Area Expansion

Estimates of service area growth in those communities serving less than 100 percent of the population were developed from discussions with, and information from, local water supply system managers and from historical data relating to the expansion of the service area in response to, or in anticipation of, population growth within a community.

In general, water supply agency officials in the Hudson River basin indicated that the percentage of their community's population served by the public water supply system will most likely remain constant or increase slightly through 2020.

Systems operating in Cheshire and Clarksburg are relatively small and have no plans to expand distribution systems. The Cheshire Water Department is projected to continue serving approximately 60 percent of Cheshire's population and the Hutchinson Water Company is expected to continue serving approximately 9 percent of Cheshire's population. The Redmills/Briggsville Water Supply Company will continue to serve approximately 10 percent of Clarksburg's population.

The Williamstown Water Department has indicated that the town has no plan for significant increases in service population. Williamstown foresees some new water service connections but indicates that the town will remain at approximately 80 percent served through 2020.

Providing water supply service to areas of high relief and low population density in Cheshire, Clarksburg, and Williamstown is not cost effective,according to water supply agency officials. Existing homes and new developments outside of existing water supply service areas will continue to be supplied by on-site wells.

Water supply systems operating in Adams and North Adams serve over 90 percent of each community's population. The Adams Fire District officials estimate that service population will remain at approximately 95 percent of Adams population. The service population in North Adams is expected to increase by approximately 2 percent, from 97 percent to 99 percent by 1995, and remain at 99 percent through 2020. A small percentage of the population of Adams and North Adams is not expected to be served during the planning period as they reside in areas of high elevation where costs associated with maintaining adequate water pressure are quite high. The out-of-town population served by North Adams in Clarksburg (100) and Williamstown (64) is expected to remain constant through 2020.

The communities of Hancock, Mount Washington, and New Ashford are not projected to develop public water supply systems by 2020 and are expected to remain 100 percent self-supplied.

Table 14 lists current and projected 2020 service population for the communities located in the Hudson River basin.

TABLE 14

2020 SERVICE POPULATION PROJECTIONS
HUDSON RIVER BASIN

Community/ Agency	1986 Federal Census Estimate	1987 Percent Served	1987 Out of Town Customers	1987 Service Population	2020 Projected Population	2020 Percent Served	2020 Out of Town Customers	2020 Service Population
ADAMS	10,080				9,666			
Fire District		94%	0	9,475		95%	0	9,183
CHESHIRE	3,340				3,293			
Water Department		59%	0	1,971		60%	0	1,976
Hutchinson Water Co.		9%	0	301		9%	0	296
CLARKSBURG	1,790				1,713			
Redmills/Briggsville		10%	0	179		10%	0	171
HANCOCK	600	0%	-		600	0%	-	
MOUNT WASHINGTON	100	0%	-		100	0%	-	
NEW ASHFORD	140	0%	-		160	0%	-	
NORTH ADAMS	17,020				16,095			
Water Department		97%	164	16,673		99%	164	16,098
WILLIAMSTOWN	8,090				7,800			
Water Department		80%	0	6,472		80%	0	6,240
TOTALS	41,160	85%	164	35,071	39,427	86%	164	33,964

VI. PROJECTED WATER DEMANDS

1. Introduction

It is projected that by 2020, public water suppliers in the Hudson River basin will have to meet an average day demand (ADD) of 7.02 mgd and a maximum day demand (MDD) of 10.27 million gallons.

ADD is the quantity of water used by a community during the year, divided by 365 (366 if a leap year). MDD is the highest volume of water a community will use on a single day. The MDD reflects variations in water demand and is an important consideration in evaluating a community's water conservation potential and in planning future water system requirements. DWR water demand projections rely on an analysis of demographic and water demand trends described below and in Appendix 2.

2. Components

Each component of DWR water demand projection methodology is described in Appendix 2, Projection Methodology, and Table 18 lists the results of each calculation for the year 2020. Several key components of the methodology are described below.

Base Demand: DWR has selected the three most recent years' average water use as representative of a community's current water demand and defines that average as the base water demand. The present base water demand for the Hudson River basin communities is 6.00 mgd (Table 15). Looking at a longer historical trend in water use may yield an unrealistically low current demand figure if demand has increased in recent years. Using the most recent year's water demand may be unrepresentative of current demand due to single severe events (such as a large fire or water main leak). In communities with little or no recent change in demand, the three year base demand is likely to be similar to longer term average demand. For each community, projected change in water demand is added to the base demand which yields projected water demand.

Anticipated Significant Changes in Water Use: When a community is expected to experience a significant change in water demand during the planning period due to a water dependent development, this information is included as a component of the projections.

A large development is being proposed in the Town of Adams which would rely upon the Adams Fire District for water supply. The projected water supply needs for the project upon completion is estimated to be approximately 0.35 million gallons per day. For planning purposes, this report considers the expected impact of the proposed development as an increase in average day demand on the Adams Fire District of 0.1 mgd in 1995, 0.1 mgd in 2020 and 0.15 mgd in 2010.

Base MDD and MDD/ADD Ratio: Projecting maximum day demand for a public water supply system is important so that future water

supply, distribution, and storage systems can deliver water under MDD conditions. Water supply systems that depend heavily on ground water are most vulnerable to MDD problems since the yield of ground water is often limited, supply wells have limited pumping capacities, and storage capacity may be limited. Surface water sources offer more flexibility in meeting MDD as long as the water levels are high enough to prevent water quality problems. Base MDD is the average of the reported maximum day demands for a study area community during each year of the three year period from 1985 to 1987.

In order to project maximum day demands, it is necessary to derive a ratio of MDD to ADD. This is done by dividing a community's MDD by its ADD for each year of the three-year base period (1985-1987) and then averaging these results to obtain a base MDD/ADD ratio (Table 15). This base ratio is then multiplied by the projected ADD to obtain the projected MDD.

The MDD in the Hudson River basin is projected to increase from the base MDD of 8.84 mgd to 10.27 mgd by 2020, a 16 percent increase. The MDD projections assume that the base MDD/ADD ratio will remain constant over the planning period. Tables 16 and 17 list the projected average day and maximum day demands from 1995 to 2020, including the volume and percentage increases.

3. Water Demand Projection Assumptions

The projections are regarded as estimates of future water demand. These estimates are based on DWR's assumptions of what will be occurring in the area during the next thirty years.

The population forecasts prepared by MISER and DWR were based on state and county growth patterns. Where appropriate, population projections are adjusted with input from local officials concerning specific growth patterns and restrictions.

Public water supply service areas are expected to expand during the next 33 years. In communities where more than 90 percent of the population is served, the percentage is assumed to increase to 100 percent, unless otherwise specified. Those communities currently under 90 percent will increase as specified earlier in Table 14.

Gallons per capita day (gpcd) is assumed to remain at the 1987 level until 1990. Assuming moderate conservation, it is expected that from 1990 to 2020 the gpcd will increase five percent per decade, based on statewide water use experience since 1980.

4. Summary

The average day demand of the study area is projected to increase by 17 percent from the base average day demand (1985-1987 three year average) of 6.00 mgd to 7.02 mgd in 2020. The maximum day demand of the study area is projected to increase by 16 percent from the base maximum day demand of 8.84 million gallons to 10.26 million gallons in 2020. Figure 7 illustrates changes in water demand from 1980 through 1987 and projected changes in water use

from 1987 through 2020. The projected change in water demand, from the base to 2020 demand, for public water supply systems in the Hudson River basin is illustrated below.

Demand on Public Water Supply Systems

	1985-1987 Base	2020 (Projected)	Increase in Demand	Percent Increase
Average Day Demand	6.00 mgd	7.02 mgd	1.02 mgd	17 %
Maximum Day Demand	8.84 mgd	10.27 mgd	1.43 mgd	16 %

TABLE 15

BASE AVERAGE DAY DEMAND (mgd) AND MDD/ADD RATIO

COMMUNITY/ AGENCY	1985 ADD mgd	1985 MDD mgd	1985 MDD/ADD RATIO	1986 ADD mgd	1986 MDD mgd	1986 MDD/ADD RATIO	1987 ADD mgd	1987 MDD mgd	1987 MDD/ADD RATIO	BASE ADD	BASE MDD/ADD RATIO
ADAMS											
FIRE DISTRICT	1.98	2.66	1.34	1.97	2.55	1.29	2.03	2.57	1.27	1.99	1.30
CHESHIRE											
WATER DEPARTMENT	0.19	0.26	1.37	0.15	0.23	1.53	0.15	0.32	2.13	0.16	1.68
HUTCHINSON WATER CO.	0.03	0.04	1.33	0.03	0.04	1.33	0.03	0.04	1.33	0.03	1.33
CLARKSBURG											
REDMILLS/BRIGGSVILLE	0.01	0.01	1.00	0.01	0.01	1.00	0.01	0.01	1.00	0.01	1.00
NORTH ADAMS											
WATER DEPARTMENT	2.89	4.34	1.50	2.78	4.17	1.50	2.96	4.44	1.50	2.88	1.50
WILLLIAMSTOWN											
WATER DEPARTMENT	0.86	1.17	1.36	0.96	2.13	2.22	0.97	1.53	1.58	0.93	1.72
TOTALS	5.96	8.48		5.90	9.13		6.15	8.91		6.00	

TABLE 16

1995-2020 AVERAGE DAY DEMAND (ADD) PROJECTIONS
HUDSON RIVER BASIN
million gallons per day (mgd)

Community/ Agency	1985	1986	1987	1985-1987 Base ADD	1995	2000	2010	2020	Volume Increase from 1985-87 to 2020	Percent Increase from 1985-87 to 2020
ADAMS										
Fire District	1.98	1.97	2.03	1.99	2.08	2.22	2.47	2.57	0.58	29%
CHESHIRE										
Water Department	0.19	0.15	0.15	0.16	0.16	0.17	0.18	0.18	0.02	12%
Hutchinson Water Co.	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00	0%
CLARKSBURG										
Redmills/briggsville	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0%
NORTH ADAMS										
Water Department	2.89	2.78	2.96	2.88	2.85	2.92	3.06	3.20	0.32	11%
WILLIAMSTOWN										
Water Department	0.86	0.96	0.97	0.93	0.92	0.94	0.99	1.03	0.10	11%
TOTALS	5.96	5.90	6.15	6.00	6.05	6.29	6.74	7.02	1.02	17%

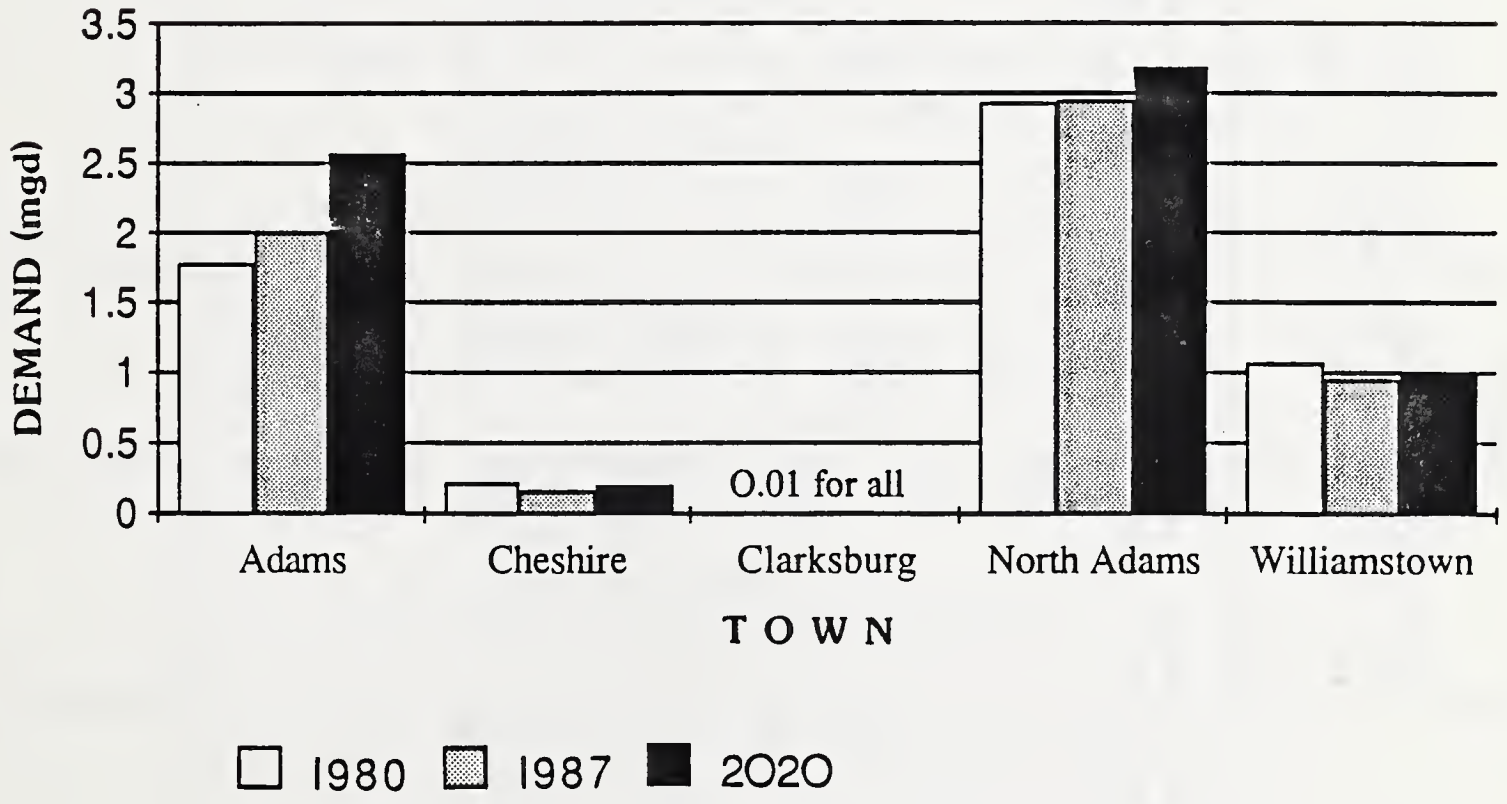
TABLE 17

1995-2020 MAXIMUM DAY DEMAND (MDD) PROJECTIONS
HUDSON RIVER BASIN
million gallons per day (mgd)

Community/ Agency	1985	1986	1987	1985-1987 Base MDD	1995	2000	2010	2020	Volume Increase from 1985-87 to 2020	Percent Increase from 1985-87 to 2020
ADAMS										
Fire District	2.66	2.55	2.57	2.59	2.70	2.90	3.21	3.34	0.75	29%
CHESHIRE										
Water Department	0.26	0.23	0.32	0.27	0.27	0.29	0.30	0.30	0.03	11%
Hutchinson Water Co.	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.00	0%
CLARKSBURG										
Redmills/briggsville	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0%
NORTH ADAMS										
Water Department	4.34	4.17	4.44	4.32	4.28	4.38	4.59	4.80	0.48	11%
WILLIAMSTOWN										
Water Department	1.17	2.13	1.53	1.61	1.59	1.63	1.71	1.78	0.17	11%
TOTALS	8.48	9.13	8.91	8.84	8.89	9.25	9.86	10.27	1.43	16%

FIGURE 7

HUDSON RIVER BASIN
1980, 1987, AND PROJECTED 2020
AVERAGE DAY DEMAND



Prepared by DEM/Division of Water Resources

TABLE 18

2020 WATER DEMAND PROJECTIONS
HUDSON RIVER BASIN
million gallons per day (mgd)

COMMUNITY/ AGENCY	1986 FEDERAL CENSUS	1987 % SERVICE POPULATION	1987 OUT OF TOWN POPULATION	1987 BASE SERVICE POPULATION	1985-1987 AVG DAY DEMAND	1985-1987 AVG GPCD	2020 POPULATION PROJECTION	2020 MINIMUM SERV. POP.	2020 PRELIMINARY ADD	2020 PERCENT SERV POP	2020 ADJ SERVICE POPULATION	2020 ADJUSTED ADD	2020 GPCD	2020 PRELIM ADJUSTED ADD	ANTICIPATED SIGNIFICANT CHANGES IN WATER USE	2020 ADJUSTED ADD	1985-87 MDD/ADD RATIO**	2020 MAX DAY DEMAND
ADAMS	10080						9666											
FIRE DISTRICT		94%	0	9475	1.99	210		9086	1.91	95%	9183	1.93	242	2.22	0.35	2.57	1.30	3.34
CHESHIRE	3340						3293											
WATER DEPARTMENT		59%	0	1971	0.16	81		1943	0.16	60%	1976	0.16	93	0.18	0.00	0.18	1.68	0.30
HUTCHINSON WC		9%	0	301	0.03	100		296	0.03	9%	296	0.03	115	0.03	0.00	0.03	1.33	0.04
CLARKSBURG REDMILL	1790						1713											
BRIGGSVILLE W.S.		10%	0	179	0.01	56		171	0.01	10%	171	0.01	64	0.01	0.00	0.01	1.00	0.01
HANCOCK *	600	0	0	0			600	0	0	0								
NEW ASHFORD *	100	0	0	0			100	0	0	0								
MT. WASHINGTON *	140	0	0	0			160	0	0	0								
NORTH ADAMS	17020						16095											
WATER DEPARTMENT		97%	164	16673	2.88	173		15776	2.73	99%	16098	2.78	199	3.20	0.00	3.20	1.50	4.80
WILLIAMSTOWN	8090						7800											
WATER DEPARTMENT		80%	0	6472	0.93	144		6240	0.90	80%	6240	0.90	165	1.03	0.00	1.03	1.72	1.78
TOTALS	41160		164	35071	6.00		39427				33964	5.81		6.67	0.35	7.02		10.27

* Communities with no public water supply that are expected to remain self-supplied by on-site wells throughout the planning period (see Appendix 3-A).

** See Table 15, page 32, for derivation of MDD/ADD Ratio.

APPENDIX 1

Hudson River Basin Study Area
Public Water Supply Agencies

Community	Water Supply Agency and Address	Telephone Number
Adams	Adams Fire District 3 Columbia Street Adams, MA 01220	(413) 743-0978
Cheshire	Cheshire Board of Water Commissioners Cheshire Water Department 16 Depot Street Cheshire, MA 01225	(413) 743-1356
	Hutchinson Water Company Cheshire Hills Cheshire, MA 01225	(413) 743-5713
Clarksburg	Red Mills / Briggsville Water Supply Demers Avenue Clarksburg, MA 01247	(413) 663-7978
North Adams	North Adams Water Department City Hall 10 Main Street North Adams, MA 01247	(413) 663-6765
Williamstown	Williamstown Water and Sewer Department 31 North Street Williamstown, MA 01267	(413) 458-3383

APPENDIX 2

General Water Demand Projection Methodology

This appendix describes the twenty steps in the methodology used to project water demand for the period 1995-2020. The purpose for each step, source of information, and formula, if applicable, are described. The projected water demands projected by this methodology are accurate provided that the assumptions underlying the various steps remain valid. For example, the methodology uses population projections prepared by the Massachusetts Institute for Social and Economic Research and input from municipal officials. If actual population growth is substantially different from these projections, the actual water use also will differ from projected demands.

The assumptions built into this methodology are based on analyses of future trends developed from literature, consultants reports and a review of recent experience of water demand fluctuations and conservation efforts in Massachusetts.

The twenty steps are as follows:

1. Communities included in the Basin Study Area
2. 1986 Federal Census Estimate
3. 1987 Percent Service Population
4. 1987 Seasonal and Out-of-Town Population
5. 1987 Base Service Population
6. 1985-1987 Average Day Demand
7. 1985-1987 Average Annual Gallons per Capita Day (gpcd)
8. 2020 Population Projections
9. 2020 Minimum Service Population
10. 2020 Preliminary Average Day Demand
11. 2020 Increase in Percent Service Population
12. 2020 Adjusted Service Population (Part 1)
13. Local Population Refinements
14. 2020 Adjusted Service Population (Part 2)
15. 2020 Gallons per Capita Day (gpcd)
16. Preliminary Adjusted 2020 Average Day Demand
17. Significant Changes Anticipated in Water Use
18. Adjusted 2020 Average Day Demand
19. 1985-1987 Maximum Day to Average Day Day Ratio
20. 2020 Maximum Day Demand

STEP 1: Communities Included in The Basin Study

A community is included in the river basin study if it is located mostly within the basin or if it has public water supply sources in the basin. Therefore, communities that are not geographically located within the boundaries of the river basin may be included in the river basin study.

STEP 2: 1986 Federal Census Estimate

The 1986 Federal Census estimate figures, obtained from the U.S. Bureau of Census, were used as the most recent estimates of population.

STEP 3: 1987 Service Population

This figure represents the percentage of the community's population that was served by a public water supply system in 1987. A 90 percent service population means that 90 percent of the community is served by a public supply system, and the other 10 percent is self-supplied (relying entirely on individual private wells) or is being supplied by connections with other water systems.

This figure was obtained from the updated Municipal Water Resources Management Plan - Phase II questionnaire and confirmed by DWR personnel in interviews with water superintendents.

STEP 4: 1987 Seasonal Population and/or Out-of-Town Population

Some study area communities have significant seasonal populations. In order to calculate an accurate annual average gallons per capita per day (gpcd) and future water demand, it is necessary to estimate an adjusted service population which reflects the increased seasonal population.

Local water superintendents or community planning boards usually can estimate the peak seasonal population but have little hard data with which to estimate the distribution of the seasonal population. Gordian Associates (1979) in their analysis of Regional Solid Waste Alternatives for Martha's Vineyard found that the relationship between the winter and summer populations can be represented by a bell-shaped curve with the July population being the highest point on the curve. The August population is approximately 75 percent of the peak July population, and the September and June populations are 25 percent of the July peak. From October to May the population remains constant at the year-round figure. Gordian Associates developed a formula which approximates this relationship and, in simple terms, states that every 100 seasonal residents is equivalent to 18.75 persons using water service on a year-round basis.

Peak seasonal population was obtained from the Municipal Water Resources Management Plan - Phase II questionnaires. This figure was multiplied by 0.1875 to obtain the seasonal population factor.

Out-of-town population is defined as any population outside of a community that is served by the community's public water supply system. In these cases, care was taken to subtract this population from the service population of their resident communities to avoid double counting. For planning purposes, it is assumed that the seasonal and out-of-town populations of the basin will remain constant throughout the planning period, unless other specific information is available.

STEP 5: 1987 Base Service Population

The population figures obtained in Steps 3 and 4 were added to obtain the 1987 Base Service Population.

STEP 6: 1985-1987 Base Average Day Demand (ADD)

The 1985-1987 Base (ADD) was obtained by averaging the water supply systems' 1985, 1986, 1987 net water consumption. Net water consumption is the water pumped from sources plus water purchased from other systems minus water sold to other systems. Net water consumption figures were obtained from the Division of Water Supply (DEQE) "Water Supply Statistics" forms. These forms are submitted to DEQE by each water supply agency in the spring and report the total water pumped by the system for the previous calendar year.

The ADD, in millions of gallons per day (mgd), represents the total average day water consumption. This includes domestic, commercial, institutional, industrial, agricultural, and municipal uses, as well as unaccounted for water use. Unaccounted for water includes unmetered water, leakage, fire hydrant use, street washing, and distribution system flushing.

STEP 7: 1985-1987 Base Average Gallons Per Capita Day (GPCD)

Base Gallons per Capita Day (gpcd) for a community was obtained by dividing the ADD figure obtained in Step 6 by the 1987 Base Service Population obtained in Step Five.

STEP 8: 2020 Population Projections

Population projections were estimated by DWR and based on published population projections by the Massachusetts Institute for Social and Economic Research (MISER). The MISER projections were based on the 1980 Federal census and the 1986 federal census estimate.

STEP 9: 2020 Minimum Service Population

This figure is the service population that would occur in 2020 assuming no growth in the area served and no increase in the seasonal population. This figure was obtained by multiplying the 1987 percent service population by the 2020 population projection and adding seasonal and out-of-town customers.

STEP 10: 2020 Base Average Day Demand

The 2020 base average day demand is the estimated minimum average day demand needed by the community's service population. This figure assumes no change in gallons per capita use except for the projected community population growth or decline.

STEP 11: 2020 Increase in Percent Service Population

It is assumed that in communities where the service population is less than 100 percent of its census population, the percentage of people served will increase during the planning period. The estimates of service area growth were developed from discussions with local water supply system managers and from historical experience with service area development in response to, or in anticipation of, population growth within a community.

STEP 12: 2020 Preliminary Adjusted Service Population (Part 1)

This figure represents the estimated service population if the anticipated service area increase occurs. The figure is obtained by multiplying the 2020 percent service population by the 2020 population projection and adding the 1987 seasonal population factor and any out-of-town customers.

STEP 13: Local Population Refinements

Occasionally, local planning departments have prepared their own population projections based upon detailed analysis of the dynamics occurring within their community. These planning departments are asked to compare their figures with the population projections prepared by DWR. If after the review, the planning department feels that their projections are more accurate and DWR concurs, these figures are used.

STEP 14: 2020 Adjusted Service Population (Part 2)

This figure is the 2020 service population adjusted to reflect local planning department input to the population projections. This figure is obtained by multiplying the 2020 increase in percent service population by the local 2020 population projections and then adding the seasonal population factor where applicable, and any out-of-town customers.

STEP 15: 2020 Gallons Per Capita Day (gpcd)

It is assumed that gpcd will remain fairly constant until 1990. After this time, gpcd is expected to increase slightly, as residential growth, and commercial and industrial expansion rise in the future. This assumes minimum water conservation. These assumed factors are expected to cause gpcd to rise incrementally from the year 1990 to 2020, resulting in an increase of 15 percent (5 percent per decade) by 2020 for each community. Therefore, the 2020 gpcd figure is obtained by multiplying the 1985-1987 GPCD by 1.15 (15 percent). This assumption produces conservative figures for water demands.

STEP 16: Preliminary Adjusted 2020 ADD

This figure is the base 2020 average day demand adjusted to reflect the increased water demand resulting from service area expansion, local refinements to population projections and an increase of the gpcd by 15 percent from 1990 to 2020. It is obtained by multiplying the 2020 gpcd by the 2020 adjusted service population.

STEP 17: Significant Changes Anticipated in Water Use

This figure is a one-time adjustment to the estimated 2020 water demand resulting from out-of-the-ordinary changes to a community's water needs. Examples of this are the construction of a wastewater recovery plant or a fish processing plant, or the permanent closing of an industry with major water use.

STEP 18: Adjusted 2020 ADD

This figure is the 2020 ADD obtained in Step 16, adjusted to reflect a significant change in water use. It is obtained by adding or subtracting any significant changes to or from the preliminary adjusted 2020 ADD.

STEP 19: 1985-1987 Base MDD to ADD Ratio

This figure was calculated by dividing the 1985-1987 average MDD by the 1985-1987 base ADD. For planning purposes, it is assumed that this ratio will remain constant through 2020.

STEP 20: 2020 Maximum Day Demand

This figure is obtained by multiplying the adjusted 2020 ADD by the 1985-1987 base MDD/ADD ratio. It represents the potential maximum demand that may be realized on one day in 2020.

APPENDIX 3-A

1987 Self-Supplied Residential Water Use

The 1987 estimated average day demand of on-site self-supplied residential water users was approximately 0.49 million gallons per day. The table below estimates water use of the population supplied by on-site wells in the Hudson River basin.

Hudson River Basin
1987 Self-Supplied Residential Water Use

Community	1987 Self-Supplied Population	Water Use at 79 GPCD	Percent of Community Area within Hudson Basin	Est. Self-Supplied Water Use in Hudson Basin
Adams	605	0.05 mgd	98%	0.05
Cheshire	1,068	0.08	99%	0.08
Clarksburg	1,511	0.12	100%	0.12
Hancock	600	0.05	74%	0.04
Mt. Washington	100	0.01	67%	0.01
New Ashford	140	0.01	93%	0.01
No. Adams	511	0.04	95%	0.04
Williamstown	1,554	0.12	100%	0.12
TOTAL	6,089	0.48 mgd	----	0.47 mgd

Source of Data

DWR's methodology for estimating the amount of water used for domestic purposes by residents with individual on-site wells within the hydrologic boundaries of the Hudson River basin is described below.

Methodology

Step 1: Estimate the number of self-supplied residents within the study area communities.

In the 1982 Water Resources Management Plan - Phase II questionnaire 1987 update, each water supply agency manager reported the agency's service population as a portion of the 1986 federal census estimate for the community served. For this report, however, the number of self-supplied residents was estimated by subtracting the 1987 service population from the 1986 federal census estimate figures. The Phase II plan was updated by personal field visits and telephone calls to the communities.

Step 2: Determine self-supplied water use.

The 1987 self-supplied residential water use was estimated by multiplying the community's self-supplied population by 79 gallons per capita day (gpcd). The gpcd factor was taken from the "Estimated Use of Water in the U.S. in 1980" prepared by the U.S. Geological Survey. The 79 gpcd figure was used to estimate rural self-supplied use and was verified for Massachusetts in a study of water supply systems in the Parker River basin, an essentially rural area.

Step 3: Determine the amount of self-supplied residential water withdrawn from the Hudson River basin.

For those communities whose land area lies entirely within the Hudson River basin boundaries, it can be assumed that all self-supplied water is withdrawn from the basin. However, this assumption does not hold for communities lying partially within Hudson basin boundaries. In these instances, the water withdrawn from the basin was estimated based on the percentage of the land area of the community that lies within the Hudson basin. All of the homes with on-site private wells discharge wastewater via on-site septic systems located in the same basin as the wells.

APPENDIX 3-B

Private Water Companies Supplying 10,000 gallons per day or less

The seven private water supply companies with current and projected average daily demands of 10,000 gallons per day or less had a combined average day demand of approximately 0.02 mgd in 1987. Since this water use is estimated (not metered) and detailed information is not available, the water use of the population served by this group of suppliers is included in Appendix 3-A, (1987 Self-Supplied Residential Water Use.)

The table below lists these seven private water supply companies located in the Hudson River basin. It will be assumed that the service populations will remain constant throughout the planning period.

Private Water Companies Located in the Hudson River Basin Supplying 10,000 gallons per day or less

Community Location of Company	Water Company Name and Address
Cheshire	Pine Valley Mobile Home Park P.O. Box 158 Cheshire, MA 01225
	South Cheshire Goodlife Corp. Quarry Road Cheshire, MA 01225
Clarksburg	Oakes Water Company 60 Middle Road Clarksburg, MA 01247
	Whitney Water Systems Crossroads Clarksburg, MA 01247
Hancock	Shaker Heights Association Rt. 49 - Shaker Heights Pittsfield, MA 01201
	Beaver Pond Meadow c/o Jiminy Peak Corey Road Hancock, MA 01237
Williamstown	Waubeeka Springs 53 Hancock Road Williamstown, MA 01267

Sources of Data:

DEQE Water Supply Statistics Reports submitted by water companies to the regional offices of the DEQE, Division of Water Supply and/or telephone interviews with water company contacts.

APPENDIX 3-C

1987 Self-Supplied Industrial Water Use for sanitary, cooling, service and or processing purposes Hudson River Basin

Five self-supplied industrial water users with a 1987 average daily demand of 100,000 gallons per day or more have been located in the Hudson River basin. The 1987 combined average daily demand of the industries that have their own water supply sources was approximately 7.8 mgd. Three of the self-supplied industries are located in Adams, one in Hancock, and one in Williamstown. An estimate of water supplied to industries by public water supply systems is included in Section V of this report.

The table below lists the estimated average daily demands, estimated volume of water consumed, estimated volume of water returned to the basin, and the 2010 projected average daily demand of the industries as a total by community.

1987 Self-Supplied
Industrial Water Use
Hudson River Basin

Community Locatioin of Industry	Secondary Basin Location of Industry	Number of Industries using 0.10 mgd or more in town	Estimated Avg Day Demand of industries in town (mgd)	Estimated Volume of ADD Consumed (mgd)	Estimated Volume of ADD returned to basin (mgd)	2010 Projected Average Day Demand (mgd)
Adams	Hoosic	3	5.2	2.0	3.2	9.4
Cheshire	Hoosic	---	---	---	---	---
Clarksburg	Hoosic	---	---	---	---	---
Hancock	Kinderhook	1	1.7*	0*	1.7	2.8
Mt. Washington	Bashbish	---	---	---	---	---
New Ashford	Hoosic	---	---	---	---	---
North Adams	Hoosic	---	---	---	---	---
Williamstown	Hoosic	1	0.8	0.3	0.5	2.3
TOTALS		5	7.7	2.3	5.4	14.5

* In operation 6 months per year, ADD = 1.7 mgd during that period
** Negligible

Sources of Data:

Massachusetts Department of Environmental Quality Engineering, Division of Water Supply, Water Management Act Registration Form. Telephone interviews with industry representatives.

Hudson River Basin, Volume I
Inventory and Analysis of Current and Projected Water Use

ERRATA: Page 46, Appendix 3-C

Town of Adams:

Estimated volume of ADD consumed should read 1.0 instead of 2.0;

Estimated volume of ADD returned to basin should read 4.2 instead of 3.2;

Totals for the above two columns should read 1.3 (instead of 2.3) and 6.4 (instead of 5.4).

APPENDIX 4-A.

Identification and Location of Massachusetts Public Water Supply Sources in the Hudson River Basin

This appendix identifies and locates public water supply sources in the Hudson River basin. A table with water supply sources data and a map indicating sources locations are included. The following information describes the data in the table.

WATER SUPPLY AGENCY: The name of the water supply agency which operates the source.

NAME OF SOURCE: The name of the individual water source as given by the water supply agency.

1987 STATUS OF SOURCE: If the source is not being actively used, the reasons are given.

BASIN LOCATION OF THE SOURCE: The river basin in which the water supply source is located.

COMMUNITY LOCATION OF THE SOURCE: The city or town in which the water supply source is located.

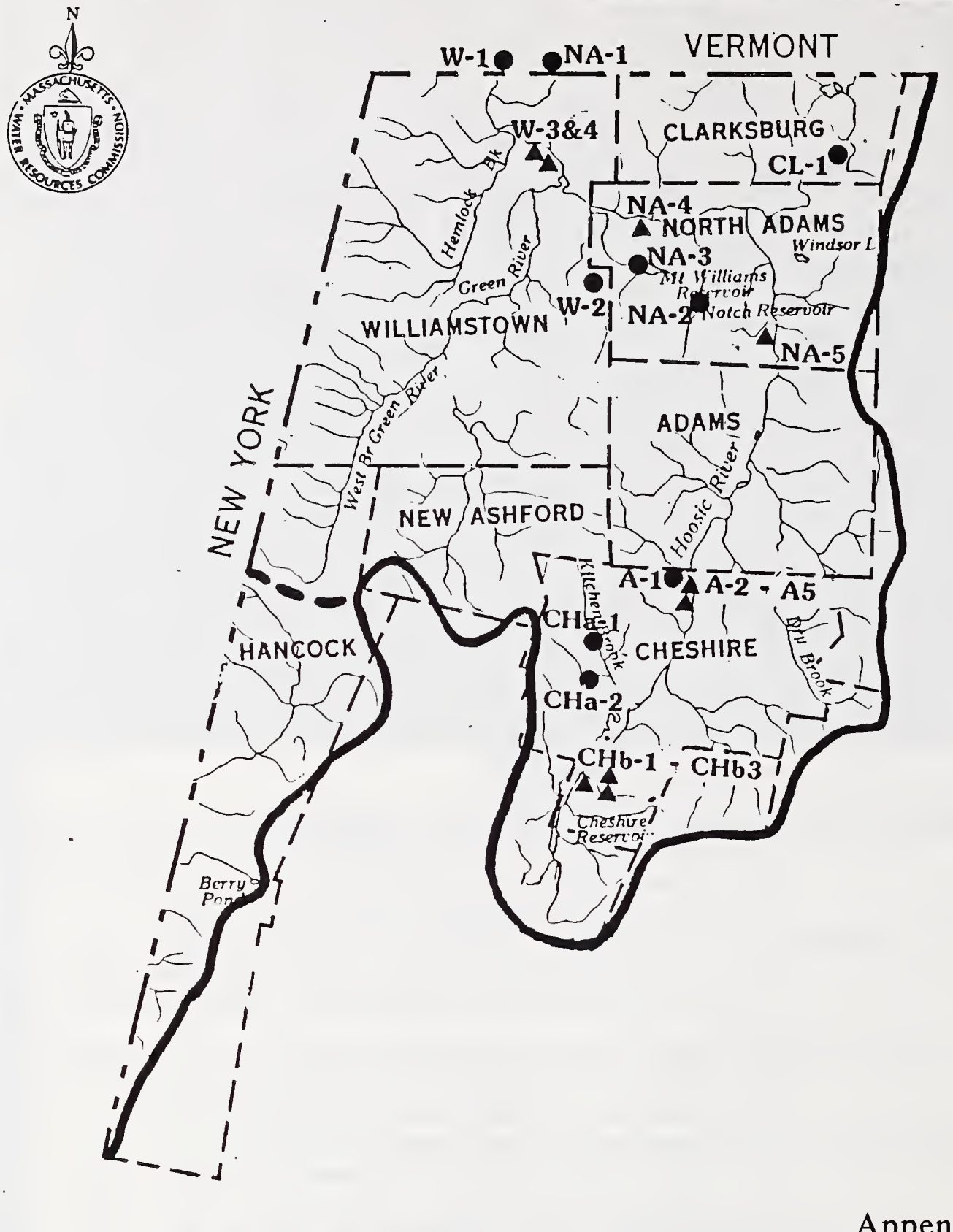
PUMPING CAPACITY OF THE SOURCE (mgd): Pumping capacity of a source is the maximum amount of water that can be pumped into the distribution system and/or from river to reservoir or reservoir to reservoir.

1987 AVERAGE DAY DEMAND OF SOURCE: This number is the total water pumped from a source in calendar year 1987, divided by 365 days.

DEQE NUMBER: The DEQE number identifies the water source according to a system designed by the Department of Environmental Quality Engineering. The numbers convey, in standard sequence, the community in which the supply is located (which is not necessarily the community it serves), the site number, and its status.

LATITUDE AND LONGITUDE: The latitude and longitude numbers are given for each individual source, except when two or more sources are in very close proximity. Using these numbers, sources can be located on USGS 7.5 minute series topographic maps.

DWR NUMBER OF SOURCE: Sources shown on the map in the following figure are numbered consecutively according to the following method. Sources are numbered according to highest ADD, with those located within the basin numbered first, and those outside the basin numbered last.



Appendix 4-B

Hudson River Basin

WATER SUPPLY SOURCES

AGENCY SOURCE LOCATIONS

A	Adams Fire District
CHa	Cheshire Water Department
CHb	Hutchinson Water Company
CL	Redmills/Briggsville Water Supply
NA	North Adams Water Department
W	Williamstown Water Department

Prepared by DEM/Division of Water Resource

APPENDIX 4-C
PUBLIC WATER SUPPLY AGENCIES & SOURCE DATA
HUDSON RIVER BASIN

Water Supply Agency & Town	Name of source	1987 Status of Source	Basin Location of Source	Community Location of Source	Pumping Capacity of Source (mgd)	1987 Avg Day Demand of Source (mgd)	DEQE Number of Source	Latitude Longitude of Source	DWR Map Symbol of Source	Notes
Adams Fire District Adams	Basset Brook Reservoir	used all year	Hudson	Cheshire	1.50	1.32	11A-058-303B	42-35-46 73-08-45	A1	
	Cheshire Harbor Well # 4	used all year	Hudson	Cheshire	2.30	0.71	11A-058-302A	42-35-13 73-08-28	A2	
	Cheshire Harbor Well # 2A	used all year	Hudson	Cheshire	1.15		11A-058-302A	42-35-11 73-08-29	A3	
	Cheshire Harbor Well # 3	not used 1987	Hudson	Cheshire	----	----	11A-058-302A	42-35-22 73-08-24	A4	under rehab.
	Cheshire Harbor Well # 1	not used 1987	Hudson	Cheshire	----	----	11A-058-201A	42-35-19 73-08-21	A5	no immed. plans to use
Cheshire Water Dept. Cheshire	Kitchen Brook Reservoir	used all year	Hudson	Cheshire	NA	0.15	11A-058-303B	42-34-10 73-10-40	CHa1	
	Thunder Brook Reservoir	Emergency use only	Hudson	Cheshire	NA	0.00	11A-058-303B	42-33-53 73-10-46	CHa2	Emergency use only
Hutchinson Water Co. Cheshire	Well no. 4	used all year	Hudson	Cheshire	0.11		11A-058-303B	42-31-46 73-10-25	CHb1	
	Well no. 3	used all year	Hudson	Cheshire	0.04	0.03	11A-058-303B	42-31-45 73-10-25	CHb2	
	Well no. 2	used all year	Hudson	Cheshire	0.05		11A-058-303B	42-31-50 73-10-47	CHb3	

PUBLIC WATER SUPPLY AGENCIES & SOURCE DATA
HUDSON RIVER BASIN

Water Supply Agency & Town	Name of source	1987 Status of Source	Basin Location of Source	Community Location of Source	Pumping Capacity of Source (mgd)	1987 Avg Day Demand of Source (mgd)	DEQE Number of Source	Latitude Longitude of Source	DWR Map Symbol of Source	Notes
Redmills/Briggsville Water Supply Company Clarksburg	Redmills\Briggs Water Supply Well	used all year	Hudson	Clarksburg	0.016	0.01	11A-063-201A	42-42-59 73-04-29	CL1	
North Adams Water Dept North Adams	Broad Brook Reservoir	used all year	Hudson	Pownal, Vt	Dependent on Streamflow	1.05	11A-209-309B	42-41-30 73-06-58	NA1	low flow problems in summer
	Notch Reservoir	used all year	Hudson	No. Adams	91 million gal. storage	0.83	11A-209-305B	42-40-15 73-08-05	NA2	Turbidity,capacity, press.,leakage problems
	Williams Reservoir	used all year	Hudson	No. Adams	200 million gal storage	0.82	11A-209-303B	42-41-05 73-09-15	NA3	" "
	Greylock Well	used Jul. thru September	Hudson	No. Adams	1.40	0.26	11A-209-202A	42-41-49 73-09-17	NA4	stand by source, used as needed
	Curran Well	not used 1987	Hudson	No. Adams	0.86	0.00	11A-209-206A	42-39-59 73-06-31	NA5	stand by source, used as needed
Williamstown Water Department Williamstown	Rattlesnake Reservoir	used all year	Hudson	Pownal, Vt.	0.60	0.36	not available		W1	high turbidity due to rain in summer
	Sherman Springs Reservoir	not used Aug. & Sept.	Hudson	Williamstown	0.60	0.24	11A-341-304B	42-41-05 73-10-13	W2	algea, high turbidity in summer
	Well # 1	used 10 months	Hudson	Williamstown	0.50	0.19	11A-341-202A	42-43-09 73-11-35	W3	
	Well #2	used 8 months	Hudson	Williamstown	1.00	0.18	11A-341-201A	42-43-09 73-11-33	W4	Iron/manganese

APPENDIX 5

Community Public Water Supply Facts and Maps

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: Adams **WATER SUPPLY AGENCY:** Adams Fire District

POPULATION:

1970 U.S. Census	1980 U.S. Census	1986 U.S. Census (1)	1990 Projected Population (2)	1995 Projected Population (2)	2000 Projected Population (3)	2010 Projected Population (3)	2020 Projected Population (3)
11,772	10,381	10,080	9,947	9,666	9,666	9,666	9,666

(1) 1986 U.S. census estimate prepared by U.S. Bureau of Census
(2) Prepared by the Massachusetts Institute for Social and Economic Research (MISER)
(3) Division of Water Resources estimate

POPULATION DENSITY:

1986 U.S. Census Estimate	Area of Community (in square miles)	1986 Population Density (persons per square miles)
10,080	22.94	439

PUBLIC WATER SUPPLY SERVICE POPULATION:

Population on Public Supply	Percent of Population on Public Supply	Population with On-Site Wells	Percent of Population with On-Site Wells
9,475	94 %	605	6 %

CURRENT PUBLIC WATER SUPPLY USE:

AVERAGE DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
1.79	1.83	1.59	2.39	2.34	1.98	1.97	2.03

MAXIMUM DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
2.40	2.28	2.00	3.30	4.29	2.66	2.55	2.57

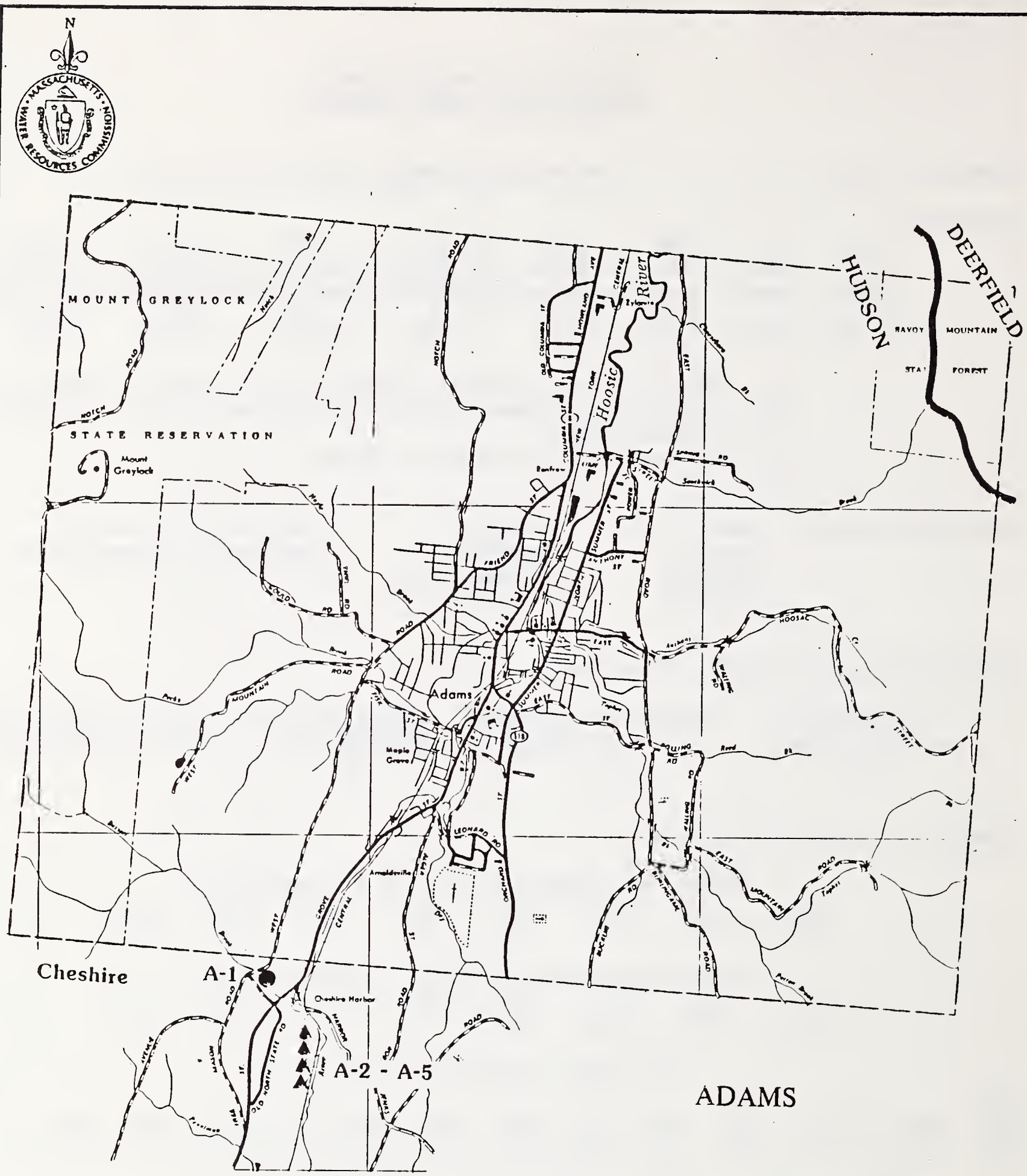
1987 MONTHLY AVERAGE DAY DEMAND (mgd)

1987 ADD	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2.03	1.66	1.91	1.86	1.84	1.90	2.37	2.45	2.57	2.12	2.13	1.77	1.80

PROJECTED WATER DEMAND:

Using DWR's standard water demand methodology, the projected water demand is as follows.

Average Day Demand (mgd)					Maximum Day Demand (mgd)				
1985-87 Base ADD	1995	2000	2010	2020	1985-87 Base MDD	1995	2000	2010	2020
1.99	1.98	2.02	2.47	2.57	2.59	2.58	2.63	3.21	3.34



LEGEND

Groundwater Source ▲

Surfacewater Source ●

Basin Boundary ▬

SCALE

Adams Fire District

Water Supply Sources:

A-1 Basset Brook Reservoir
A-2 Cheshire Harbor Well 4
A-3 Cheshire Harbor Well 2A
A-4 Cheshire Harbor Well 3
A-5 Cheshire Harbor Well 1

Prepared by DEM / Division of Water Resources

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: Adams **WATER SUPPLY AGENCY:** Adams Fire District

River Basin Acreage Distribution: **Total Acreage**

Hudson	Deerfield	14,683 acres (22.94 sq. mi.)
14,412 (98 %)	271 (2 %)	

Sources of Public Water Supply:

Name of Source	Basin Location of Source	Pumping Capacity of Source (mgd)	1987 ADD of Source (mgd)	DWR Map Symbol of Source	Notes
Basset Brook Reservoir	Hudson	1.50 mgd	1.32 mgd	A1	limited by storage capacity, problems with turbidity after heavy rain
Cheshire Harbor Well no. 4	Hudson	2.30		A2	primary source
			0.71		
Cheshire Harbor Well no. 2A	Hudson	1.15		A3	supplements reservoirs
Cheshire Harbor Well no. 3	Hudson	----	----	A4	under repair
Cheshire Harbor Well no. 1	Hudson	----	----	A5	not used, no immediate plans to use

TOTAL: 1987 ADD 2.03 mgd

TOTAL: 1987 ADD on River Basin 2.03 mgd

1987 Waste Water Discharge

River Basin	Hudson
Volume Discharged by On-site Septic System	0.20 mgd
Volume Discharged by Municipal Sewer System	1.83 mgd

Note: Municipal sewer treatment plant is located in Adams and discharges effluent into the Hoosic River.

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: Cheshire **WATER SUPPLY AGENCY:** Cheshire Water Department

POPULATION:

1970 U.S. Census	1980 U.S. Census	1986 U.S. Census (1)	1990 Projected Population (2)	1995 Projected Population (2)	2000 Projected Population	2010 Projected Population	2020 Projected Population
2,935	3,124	3,340	3,344	3,293	3,293	3,293	3,293

(1) 1986 U.S. census estimate prepared by U.S. Bureau of Census
(2) Prepared by the Massachusetts Institute for Social and Economic Research (MISER)
(3) Division of Water Resources estimate

POPULATION DENSITY:

1986 U.S. Census Estimate	Area of Community (in square miles)	1986 Population Density) (persons per square mile)
3340	27.51	121

PUBLIC WATER SUPPLY SERVICE POPULATION:

Population on Public Supply	Percent of Population on Public Supply	Population with On-Site Wells	Percent of Population with On-Site Wells
1971	59%	1068	32%

CURRENT PUBLIC WATER SUPPLY USE:

AVERAGE DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
0.22	0.25	0.21	0.21	0.20	0.19	0.15	0.15

MAXIMUM DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
0.33	0.30	0.34	0.26	0.27	0.26	0.23	0.32

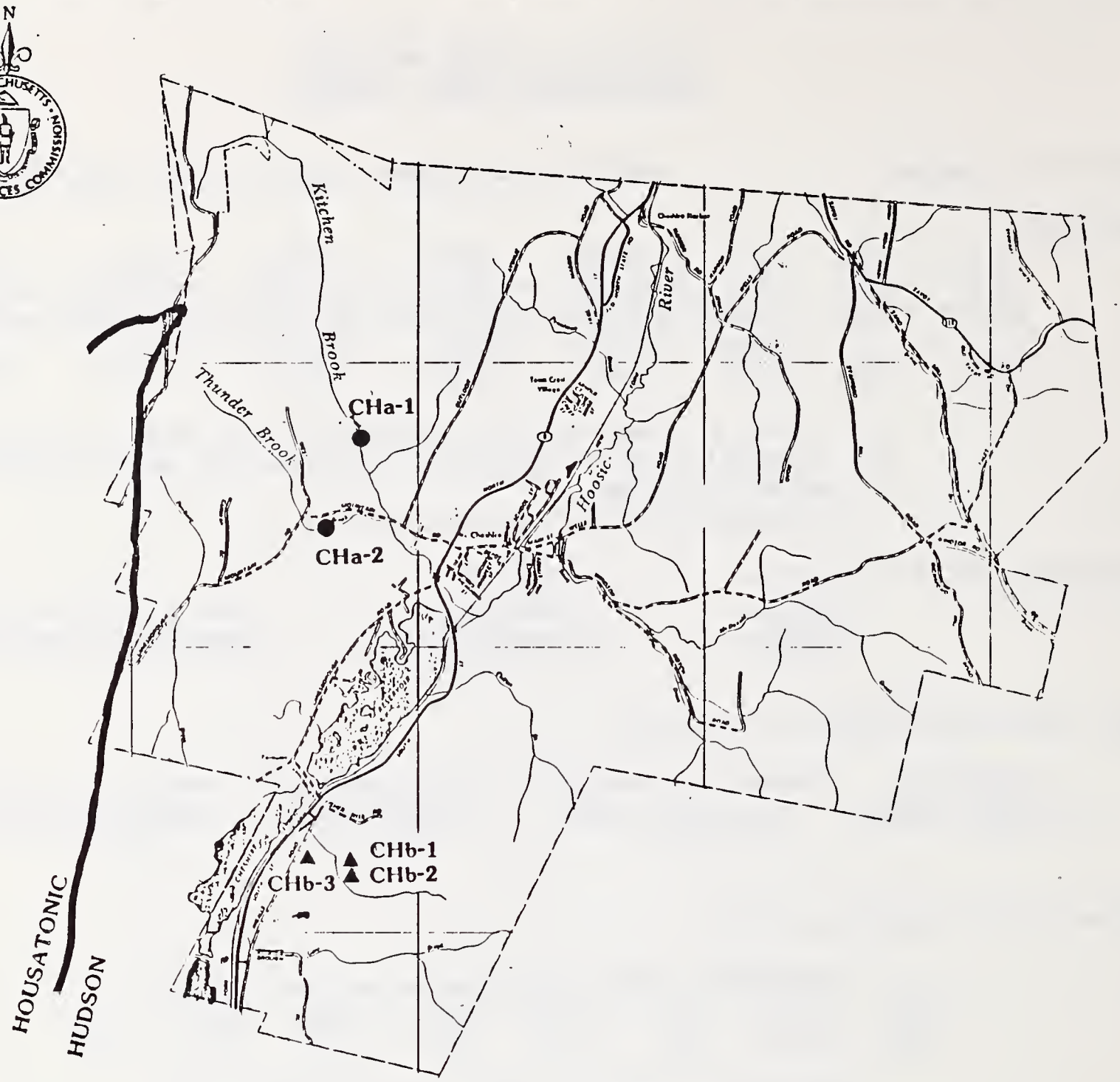
1987 MONTHLY AVERAGE DAY DEMAND (mgd)

1987 ADD	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
0.15	0.14	0.15	0.17	0.13	0.14	0.15	0.15	0.17	0.11	0.15	0.15	0.17

PROJECTED WATER DEMAND:

Using DWR's standard water demand methodology, the projected water demand is as follows.

Average Day Demand (mgd)					Maximum Day Demand (mgd)				
1985-87 Base ADD	1995	2000	2010	2020	1985-87 Base MDD	1995	2000	2010	2020
0.16	0.16	0.17	0.18	0.18	0.27	0.27	0.29	0.30	0.30



CHESHIRE

LEGEND

Groundwater Source ▲

Surfacewater Source ●

Basin Boundary ▬

SCALE

Cheshire Water Department
Water Supply Sources:

CHa-1 Kitchen Brook Reservoir
CHa-2 Thunder Brook Reservoir

Hutchinson Water Company
Water Supply Sources:

CHb-1 Well 4
CHb-2 Well 3
CHb-3 Well 2

Prepared by DEM / Division of Water Resources

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: Cheshire **WATER SUPPLY AGENCY:** Cheshire Water Department

River Basin Acreage Distribution:

Hudson	Housatonic
17547 (99%)	59 (1%)

Total Acreage: 17606 acres (27.51 sq. miles)

Sources of Public Water Supply:

Name of Source	Basin Location of Source	Pumping Capacity of Source (mgd)	1987 ADD of Source (mgd)	DWR Map Symbol of Source	Notes
Kitchen Brook Res.	Hudson	1.0 million gallons storage	0.15 mgd	CHa 1	
Thunder Brook Res.	Hudson		----	CHa 2	emergency use only

TOTAL:	1987 ADD	0.15 mgd
TOTAL:	1987 ADD on River Basin	0.15 mgd

1987 Waste Water Discharge

River Basin	Hudson
Volume Discharged by On-site Septic System	0.15 mgd
Volume Discharged by Municipal Sewer System	----

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: Cheshire **WATER SUPPLY AGENCY:** Hutchinson Water Company

POPULATION:

1970 U.S. Census	1980 U.S. Census	1986 U.S. Census (1)	1990 Projected Population (2)	1995 Projected Population (2)	2000 Projected Population (3)	2010 Projected Population (3)	2020 Projected Population (3)
2,935	3,124	3,340	3,344	3,293	3,293	3,293	3,293

(1) 1986 U.S. census estimate prepared by U.S. Bureau of Census
(2) Prepared by the Massachusetts Institute for Social and Economic Research (MISER)
(3) Division of Water Resources estimate

POPULATION DENSITY:

1986 U.S. Census Estimate	Area of Community (in square miles)	1986 Population Density (persons per square mile)
3,340	27.51	121

PUBLIC WATER SUPPLY SERVICE POPULATION:

Population on Public Supply	Percent of Population on Public Supply	Population with On-Site Wells	Percent of Population with On-Site Wells
301	9%	1063	32%

CURRENT PUBLIC WATER SUPPLY USE:

AVERAGE DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03

MAXIMUM DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
0.03	0.03	0.03	0.02	0.02	0.04	0.04	0.04

1987 MONTHLY AVERAGE DAY DEMAND (mgd)

1987 ADD	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
0.03	----- not metered -----											

PROJECTED WATER DEMAND:

Using DWR's standard water demand methodology, the projected water demand is as follows.

Average Day Demand (mgd)					Maximum Day Demand (mgd)				
1985-87 Base ADD	1995	2000	2010	2020	1985-87 Base MDD	1995	2000	2010	2020
0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: Cheshire **WATER SUPPLY AGENCY:** Hutchinson Water Company

River Basin Acreage Distribution:

Hudson	Housatonic
17547 (99%)	59 (1%)

Total Acreage:

17606 acres (27.51 sq. miles)

Sources of Public Water Supply:

Name of Source	Basin Location of Source	Pumping Capacity of Source (mgd)	1987 ADD of Source (mgd)	DWR Map Symbol of Source	Notes
Well #4	Hudson	0.11		CHb 1	
Well #3	Hudson	0.04	0.03 mgd	CHb 2	
Well #2	Hudson	0.05		CHb 3	
Well #1	Hudson			CHb 4	not used

TOTAL:	1987 ADD	0.03 mgd
TOTAL:	1987 ADD on River Basin	0.03 mgd

1987 Waste Water Discharge

River Basin	Hudson
Volume Discharged by On-site Septic System	0.03 mgd
Volume Discharged by Municipal Sewer System	----

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: Clarksburg **WATER SUPPLY AGENCY:** Redmills/Briggsville Water Supply

POPULATION:

1970 U.S. Census	1980 U.S. Census	1986 U.S. Census (1)	1990 Projected Population (2)	1995 Projected Population (2)	2000 Projected Population	2010 Projected Population	2020 Projected Population
1987	1871	1790	1762	1713	1713	1713	1713

(1) 1986 U.S. census estimate prepared by U.S. Bureau of Census
(2) Prepared by the Massachusetts Institute for Social and Economic Research (MISER)
(3) Division of Water Resources estimate

POPULATION DENSITY:

1986 U.S. Census Estimate	Area of Community (in square miles)	1986 Population Density (persons per square mile)
1790	12.82	140

PUBLIC WATER SUPPLY SERVICE POPULATION:

Population on Public Supply	Percent of Population on Public Supply	Population with On-Site Wells	Percent of Population with On-Site Wells
179	10%	1511	90%

CURRENT PUBLIC WATER SUPPLY USE:

AVERAGE DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

MAXIMUM DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

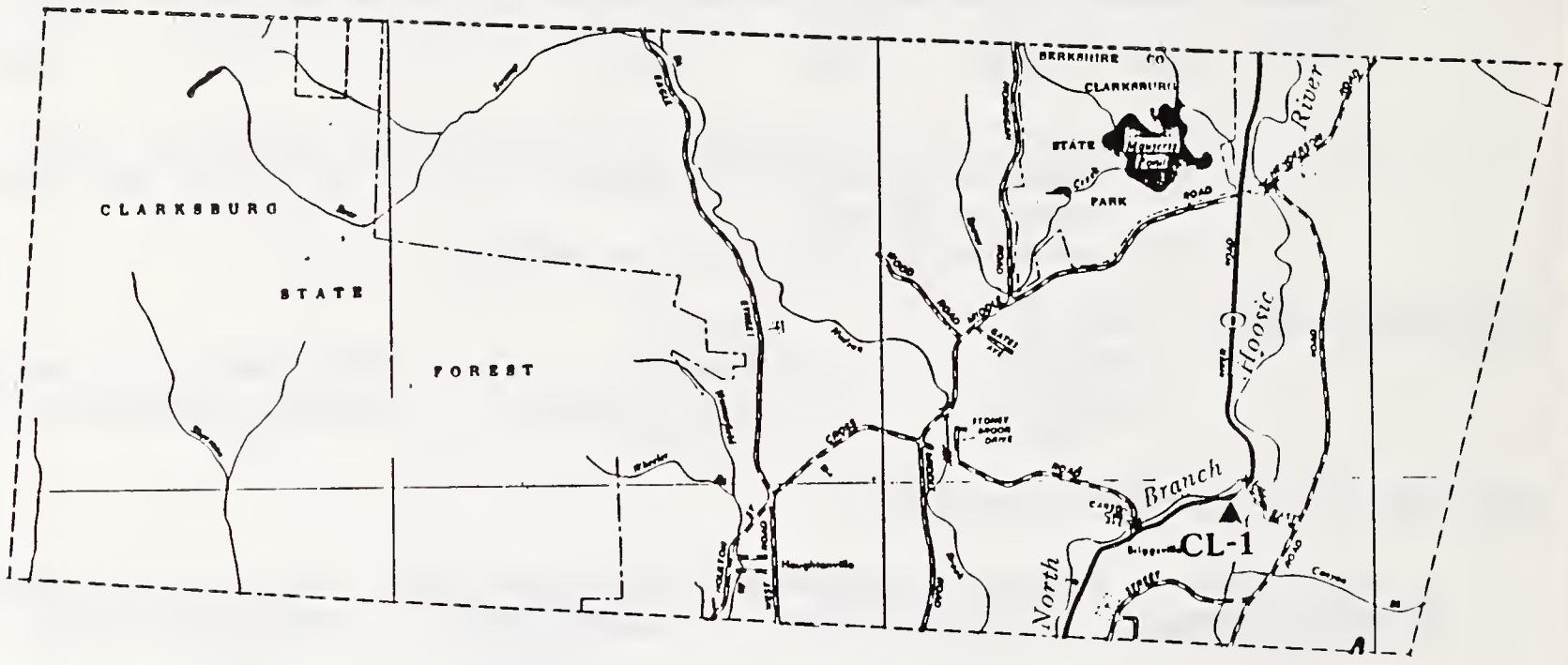
1987 MONTHLY AVERAGE DAY DEMAND (mgd)

1987 ADD	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
0.01	----- not metered -----											

PROJECTED WATER DEMAND:

Using DWR's standard water demand methodology, the projected water demand is as follows.

Average Day Demand (mgd)					Maximum Day Demand (mgd)				
1985-87 Base ADD	1995	2000	2010	2020	1985-87 Base MDD	1995	2000	2010	2020
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01



CLARKSBURG

LEGEND

Groundwater Source ▲

Surfacewater Source ●

Redmills/Briggsville Water Supply
Water Supply Sources:

CL-1 Redmills/Briggsville Water Supply Well

SCALE

Prepared by DEM / Division of Water Resources

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: Clarksburg

WATER SUPPLY AGENCY: Redmills/Briggsville Water Supply

River Basin Acreage Distribution:

Hudson
8207 (100%)

Total Acreage:

8207 acres (12.82 sq. miles)

Sources of Public Water Supply:

Name of Source	Basin Location of Source	Pumping Capacity of Source (mgd)	1987 ADD of Source (mgd)	DWR Map Symbol of Source	Notes
Red Mills/ Briggsville Water Supply Well	Hudson	0.016	0.01	CL 1	

TOTAL:	1987 ADD	0.01
TOTAL:	1987 ADD on River Basin	0.01

1987 Waste Water Discharge

River Basin	Hudson
Volume Discharged by On-site Septic System	0.01 mgd
Volume Discharged by Municipal Sewer System	----

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: North Adams **WATER SUPPLY AGENCY:** North Adams Water Department

POPULATION:

1970 U.S. Census	1980 U.S. Census	1986 U.S. Census (1)	1990 Projected Population (2)	1995 Projected Population (2)	2000 Projected Population	2010 Projected Population	2020 Projected Population
19195	18063	17020	16681	16095	16095	16095	16095

(1) 1986 U.S. census estimate prepared by U.S. Bureau of Census
(2) Prepared by the Massachusetts Institute for Social and Economic Research (MISER)
(3) Division of Water Resources estimate

POPULATION DENSITY:

1986 U.S. Census Estimate	Area of Community (in square miles)	1986 Population Density (persons per square mile)
17020	20.62	825

PUBLIC WATER SUPPLY SERVICE POPULATION:

Population on Public Supply	Percent of Population on Public Supply	Population with On-Site Wells	Percent of Population with On-Site Wells
16,509	97%	511	3%

CURRENT PUBLIC WATER SUPPLY USE:

AVERAGE DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
2.95	2.83	2.91	2.77	2.33	2.89	2.78	2.96

MAXIMUM DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
4.17	3.78	NA	3.54	3.50	4.34	4.17	4.44

1987 MONTHLY AVERAGE DAY DEMAND (mgd)

1987 ADD	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2.96	2.69	3.13	3.26	3.08	3.03	2.98	2.85	2.49	2.66	4.08	2.84	2.53

PROJECTED WATER DEMAND:

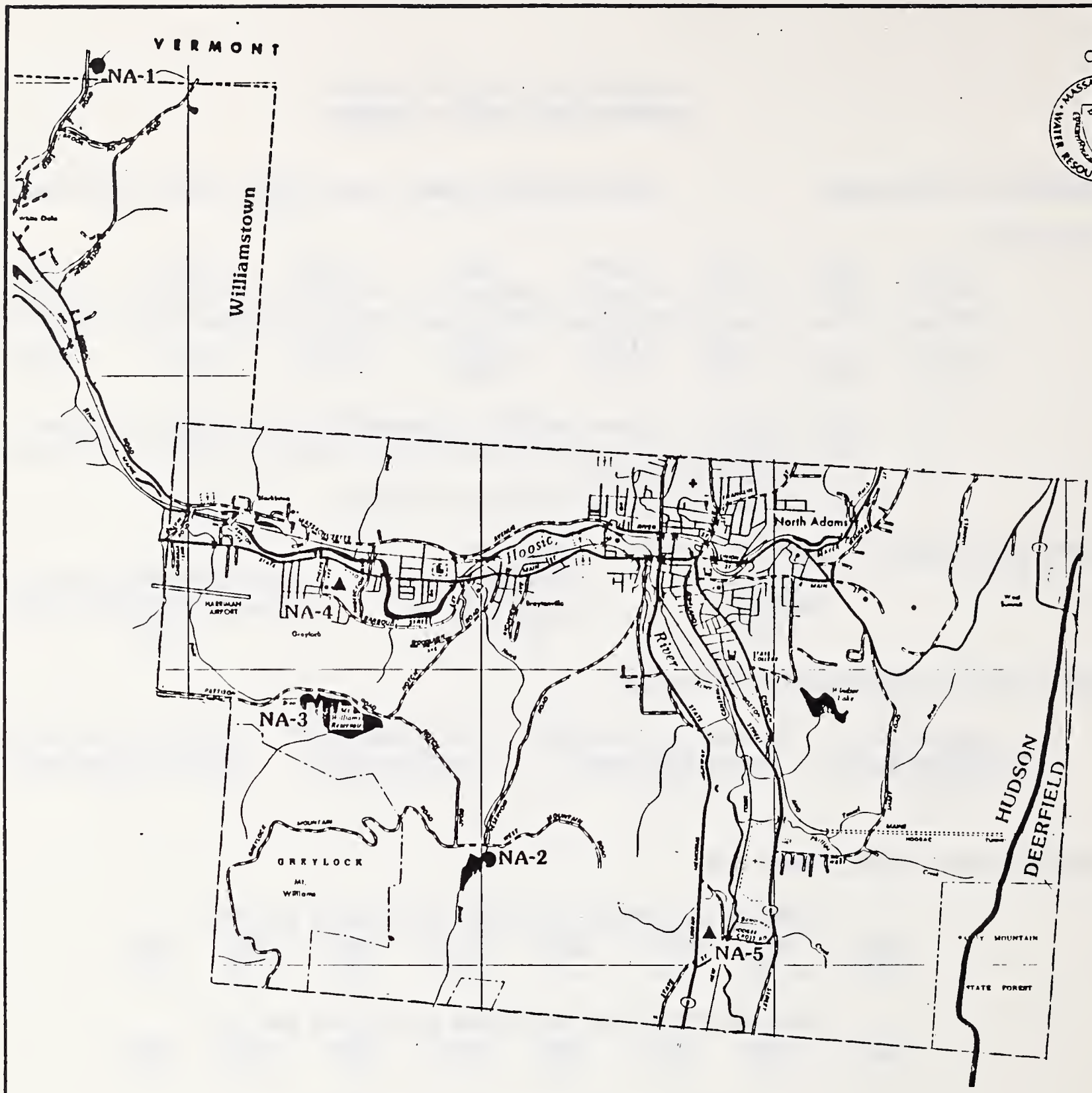
Using DWR's standard water demand methodology, the projected water demand is as follows.

Average Day Demand (mgd)

1985-87 Base ADD	1995	2000	2010	2020
2.88	2.85	2.92	3.06	3.20

Maximum Day Demand (mgd)

1985-87 Base MDD	1995	2000	2010	2020
4.32	4.28	4.38	4.59	4.80



NORTH ADAMS

LEGEND

Groundwater Source ▲

Surfacewater Source ●

Basin Boundary ——

SCALE

North Adams Water Department
Water Supply Sources:

NA-1 Broad Brook Reservoir
NA-2 Notch Reservoir
NA-3 Mt. Williams Reservoir
NA-4 Greylock Well
NA-5 Curran Well

Prepared by DEM / Division of Water Resource

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: North Adams **WATER SUPPLY AGENCY:** North Adams Water Department

River Basin Acreage Distribution:

Hudson	Deerfield
12536 (95%)	664 (5%)

Total Acreage:

13200 acres (20.62 sq. miles)

Sources of Public Water Supply:

Name of Source	Basin Location of Source	Pumping Capacity of Source (mgd)	1987 ADD of Source (mgd)	DWR Map Symbol of Source	Notes
Broad Brook Reservoir	Hudson	NR	1.05	NA	Problems: low flows in summer
Notch Reservoir	Hudson	91 mg storage	0.83	NA 2	Problems turbidity, capacity, pressure leakage
Mt. Williams Reservoir	Hudson	200 mg storage	0.82	NA 3	
Greylock Well	Hudson	1.40 mgd	0.26	NA 4	Stand by-used as needed
Curran Well	Hudson	0.86 mgd	0.00	NA 5	

TOTAL:	**1987 ADD**	2.96
TOTAL:	**1987 ADD on River Basin**	2.96

1987 Waste Water Discharge

River Basin	Hudson
Volume Discharged by On-site Septic System	0.15 mgd
Volume Discharged by Municipal Sewer System	2.81 mgd

Note: Municipal sewer treatment plant is located in Williamstown and discharges effluent into Hoosic River.

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: Williamstown **WATER SUPPLY AGENCY:** Williamstown Water Department

POPULATION:

1970 U.S. Census	1980 U.S. Census	1986 U.S. Census (1)	1990 Projected Population (2)	1995 Projected Population (2)	2000 Projected Population	2010 Projected Population	2020 Projected Population
8454	8741	8090	8006	7799	7800	7800	7800

(1) 1986 U.S. census estimate prepared by U.S. Bureau of Census
(2) Prepared by the Massachusetts Institute for Social and Economic Research (MISER)
(3) Division of Water Resources estimate

POPULATION DENSITY:

1986 U.S. Census Estimate	Area of Community (in square miles)	1986 Population Density (persons per square mile)
8090	46.73	174

PUBLIC WATER SUPPLY SERVICE POPULATION:

Population on Public Supply	Percent of Population on Public Supply	Population with On-Site Wells	Percent of Population with On-Site Wells
6472	80%	1554	19%

CURRENT PUBLIC WATER SUPPLY USE:

AVERAGE DAY DEMAND (millions gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
1.09	0.96	0.95	0.86	0.85	0.86	0.96	0.97

MAXIMUM DAY DEMAND (millions of gallons per day)

1980	1981	1982	1983	1984	1985	1986	1987
1.35	1.30	1.35	1.32	1.14	1.17	2.13	1.53

1987 MONTHLY AVERAGE DAY DEMAND (mgd)

1987 ADD	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
0.97	0.96	1.18	1.07	1.01	0.94	0.89	0.95	0.91	0.99	0.96	0.86	0.90

PROJECTED WATER DEMAND:

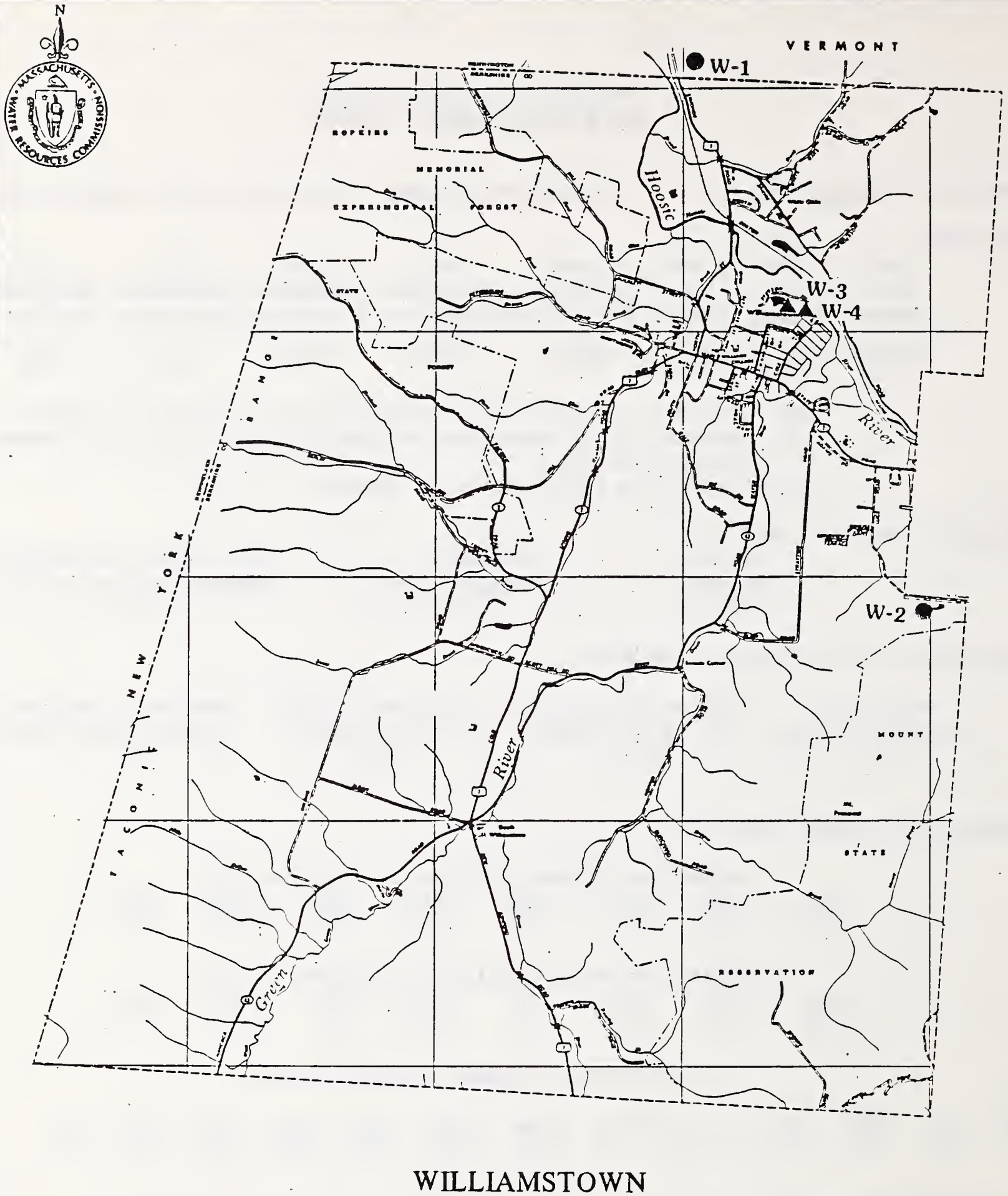
Using DWR's standard water demand methodology, the projected water demand is as follows.

Average Day Demand (mgd)

1985-87 Base ADD	1995	2000	2010	2020
0.93	0.92	0.94	0.99	1.03

Maximum Day Demand (mgd)

1985-87 Base MDD	1995	2000	2010	2020
1.61	1.59	1.63	1.71	1.78



WILLIAMSTOWN

LEGEND

Groundwater Source ▲

Surfacewater Source ●

SCALE

Williamstown Water Department
Water Supply Sources:

W-1 Rattlesnake Reservoir
W-2 Sherman Springs Reservoir
W-3 Well 1
W-4 Well 2

Prepared by DEM / Division of Water Resources

DIVISION OF WATER RESOURCES
WATER SUPPLY FACTS - SUMMARY

COMMUNITY: Williamstown **WATER SUPPLY AGENCY:** Williamstown Water Department

River Basin Acreage Distribution:
Hudson
29905 Ac (100%)

Total Acreage:
29905 acres (46.73 sq. miles)

Sources of Public Water Supply:

Name of Source	Basin Location of Source	Pumping Capacity of Source (mgd)	1987 ADD of Source (mgd)	DWR Map Symbol of Source	Notes
Rattlesnake Reservoir	Hudson	0.60	0.36	W1	Problems with turbidity due to rain in summer
Sherman Springs Reservoir	Hudson	0.60	0.24	W2	Problems with turbidity and algea
Well #1	Hudson	0.50	0.19	W3	
Well #2	Hudson	1.00	0.18	W4	Iron-manganese

TOTAL:	1987 ADD	0.97 mgd
TOTAL:	1987 ADD on River Basin	0.97 mgd

1987 Waste Water Discharge

River Basin	Hudson
Volume Discharged by On-site Septic System	0.02 mgd
Volume Discharged by Municipal Sewer System	0.95 mgd

Note: Municipal sewer treatment plant is located in Williamstown and Discharges effluent into Hoosic River.